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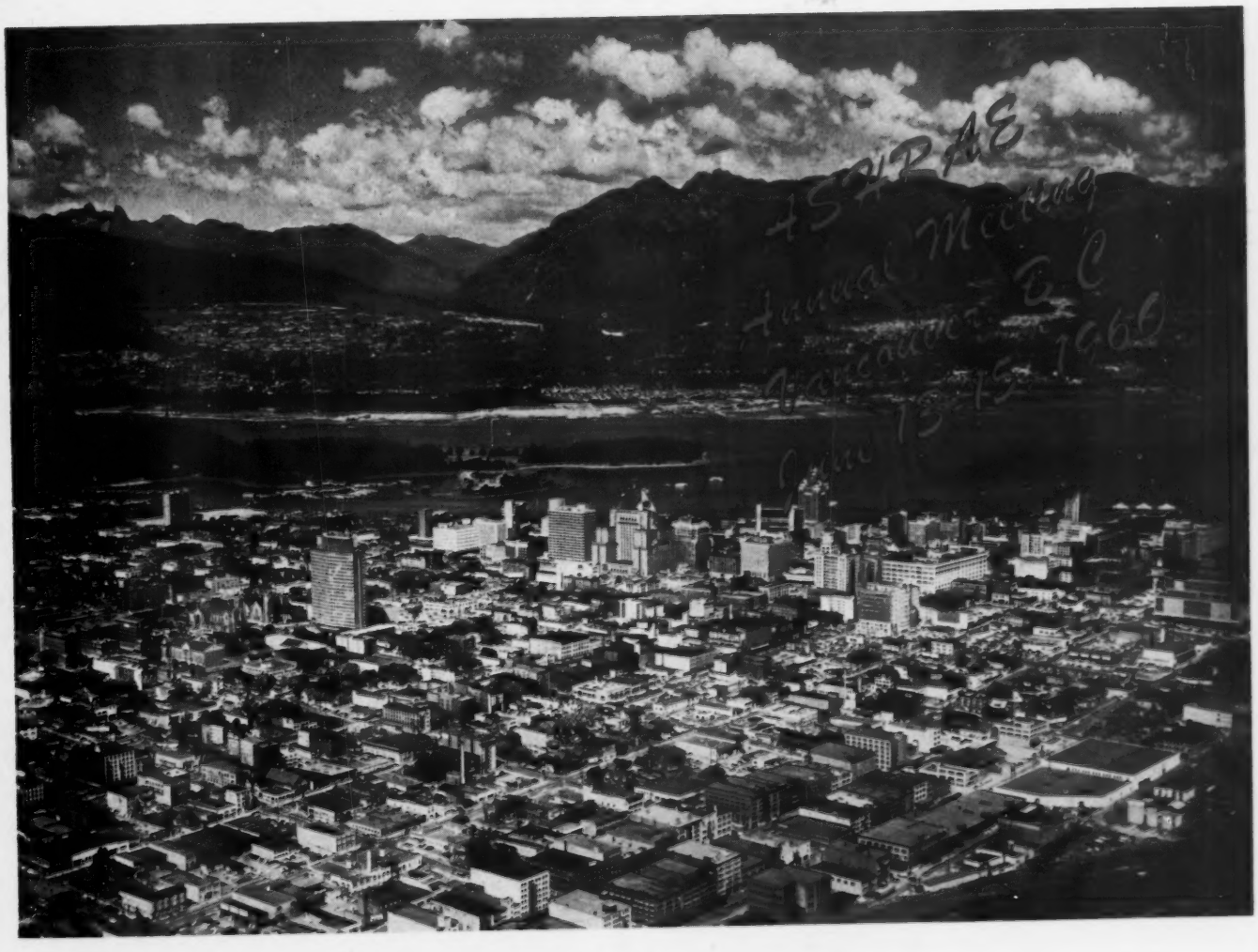
OFFICIAL PUBLICATION

JOURNAL

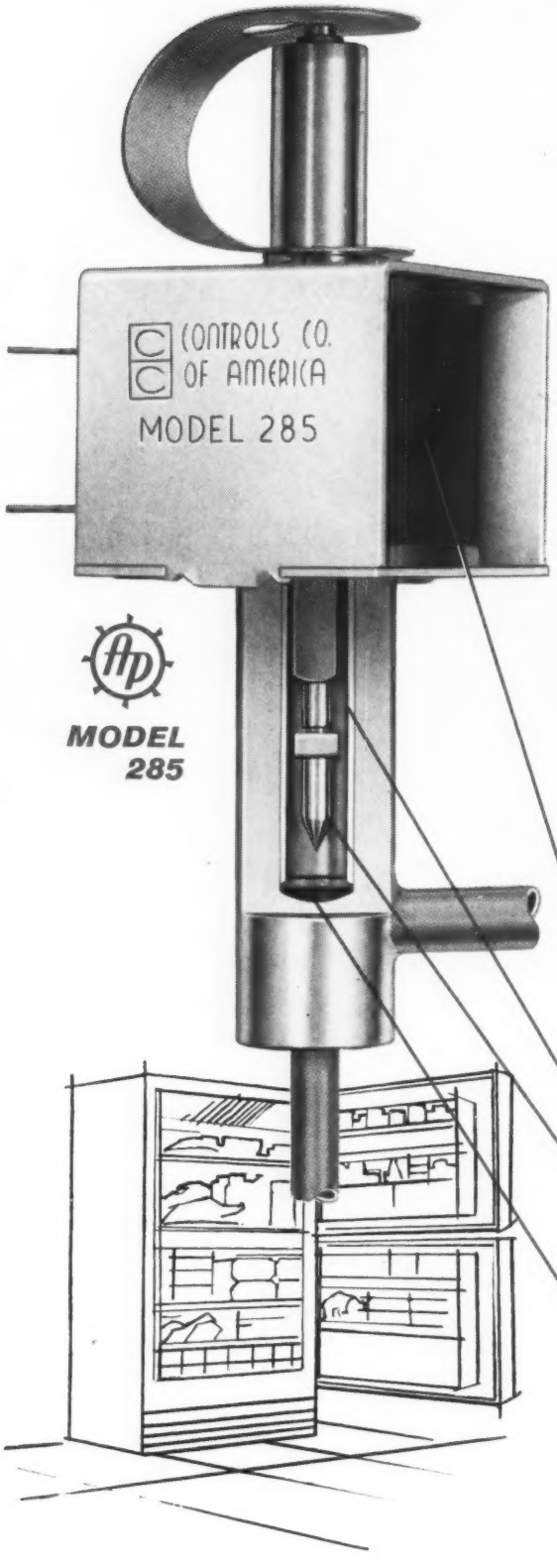
Heating • Refrigerating • Air Conditioning • Ventilating

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS



MAY 1960

Open and shut case for the only valve that offers "nonstick" dependability for refrigerators utilizing hot gas defrosting



This new Model 285 hot gas defrost valve always opens and closes on schedule, making automatic defrosting of domestic refrigerators and home freezers absolutely foolproof. Everything possible has been done by Controls Company's engineers (see cutaway) to prevent "hanging-up" and the food spoilage that results from such valve defection. That's why if you're considering hot gas defrosting, your opening move is to investigate the new A-P Model 285. Write today for full facts.

Here's how A-P engineers solved a sticky problem

SOLENOID lifts needle . . . gravity plus pressure drop closes it. Solenoid coil is encapsulated with a layer of EPOXY resin — moisture resistant for long life. Coils available with open yoke (shown) or total metal enclosure.

PLUNGER TUBE is stainless steel with "mirror-smooth" internal surface finish. Highest corrosion resistance.

STAINLESS STEEL NEEDLE slides smoothly without sticking. Head of needle is radiused to give one-point contact in open position. Edges of plunger are rounded for minimum friction and long life.

VALVE INTERIOR is polished to within 20 rms for minimum coefficient of friction. Seat as well as needle is of stainless steel adding to no-stick, long-life operation.

MISCELLANEOUS SPECIFICATIONS: 3/32" orifice. 225 lb. lift. 200 cc/minute max. leak at 200 lb. dry air. Coils for 115- or 230-volt, 60-cycle service.

Creative controls for industry

CONTROLS COMPANY OF AMERICA

HEATING AND AIR CONDITIONING DIVISION

2456 N. 32nd Street, Milwaukee 10, Wisconsin • Cooksville, Ontario • Zug, Switzerland

HAC-18-60

MAY -6 1960 B 834831

Electrowheel *

another LAU "first in the industry"

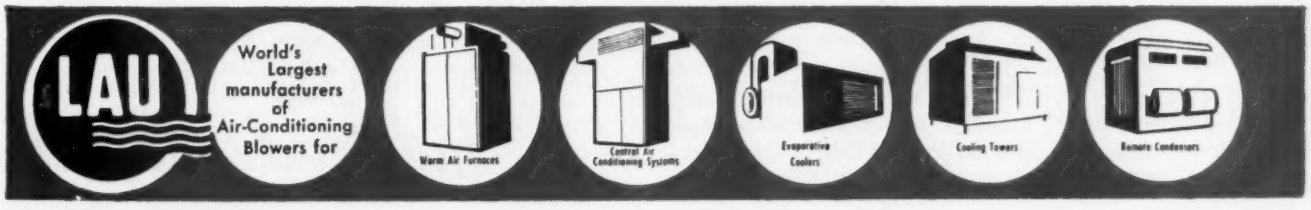
Here's another Lau first, designed to help solve those cramped space blower installation problems. The versatile Lau "Electrowheel" is recommended for use whenever air moving efficiency is a requirement but space limitations present a problem. The "Electrowheel" is extremely efficient when operating where the utmost in compactness and smooth, quiet operation is required.

Lau "Electrowheel" features include stationary rubber mounted shaft, sealed ball bearings, rigid one piece motor mounts, 30" motor leads with BX connector and the same high standard of quality found in every Lau engineered product. One moving part assures years of trouble-free service.

When an installation requires a high performance blower the Lau "Electrowheel" is the logical answer. Write for Lau Catalog LSO-463 for complete information.

**So named because a high quality external-rotor motor forms the wheel hub . . gives you more air delivery in a small package than ever before possible!*

THE LAU BLOWER COMPANY, 2027 Home Avenue, Dayton 7, Ohio



Ever hear of a bashful air-cooled condenser?

Check the new Halstead & Mitchell vertical air flow condenser

H&M's new ACV Air-Cooled Condenser with vertical air flow hates to be showy. It's so low and so quiet, you hardly know it's there—very appealing to owners, their neighbors, architects and engineers!

Roof loading is low, too, and air flow noise is directed away from surrounding structures. This delights building owners and tenants alike.

Vertical air flow models are available in 5 to 100 tons. And like all H&M Air-Cooled Condensers, the ACV series features exclusive Turbu-Flo fins, spaced wide to prevent clogging by air-borne dirt. Multiple circuiting is available for your specific needs *at no extra cost.*

Get the whole story on H&M Air-Cooled Condensers—with propeller or centrifugal fan. Ask your refrigeration wholesaler for a copy of the new bulletin AC-102. Or write to Halstead & Mitchell, Bessemer Bldg., Pittsburgh 22, Pa.

ACV SERIES —
5 TO 100 TONS

HM

Halstead & Mitchell

Air-Cooled Condensers • Finned Coil Products • Water-Cooled Condensers • Cooling Towers

MAY
1960

VOL. 2 NO. 5

OFFICIAL PUBLICATION

JOURNAL

Formerly Refrigerating Engineering including Air Conditioning, and incorporating the ASHAE Journal.

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Comment

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LET'S TAKE A VOTE

Among the things of which we despair of ever understanding is the apparently widespread notion that if enough people think something is so or act to make it so then it must be or become a reality.

"What", queried the Professor of his young and confident class, "would be the effect upon your visual sense in viewing the spokes of a large rotating wheel after you had run vigorously enough to get thoroughly out of breath? We shall vote on it in class tomorrow." Not one of the group had ever tried for such an experience; not one of them researched it. But the next day they voted it; all wrong, of course. But it was a vote.

Wars settle nothing in terms of the validity of those principles over which men so often quarrel. They merely demonstrate that might (or numbers) determines outcome.

Now engineers are spared much of this in both their work and their relationships with others for the nature of their training brings them closer to fact than to fancy. But they are not immune to the common virus either.

How long since you reached an "ought to be" decision?

How long since you projected someone else's say so into a preferred course of action?

How long since you said "The majority must be right?"

Aside from proverbial death and taxes we know of nothing that is a certainty except that "What is will not be". Change is inevitable. Tomorrow, in the making, lies revealed in every field of human activity within the realm of the "is not".

Today's minority (never mind which one) will be tomorrow's majority. By the time that takes place it is already outmoded and vulnerable to replacement by some other factor of change.

IN OUR OWN FIELDS

Indeed, while we are on the subject, we think a backward glance to be in order.

In heating, not too long ago, what was done in America was done with wood, then came coal, then gas and oil and electricity. In comfort, it was enough to be warm momentarily on one side only of course, for even recent generations before there came the successive miracles of grate fires, Franklin stoves, central systems and automatic controls now followed by properly adjusted environments of temperature, humidity and filtered, dust-free, bacteria-reduced and contaminant-controlled air. In refrigeration, from an all-absorption (ammonia) type era we have gone through an almost all-compression era to what may become a return to an absorption dominance with an admixture of thermoelectric and solar devices.

At any point along the three lines of change just cited any "competent" observer might have concluded "This is it. There is no more to be done." But you may safely conclude no true finality to any line of human endeavor. There forever remains the next step in science, engineering, the arts, medicine and human understanding.

Some minority is sure to take over and upset "the vote".

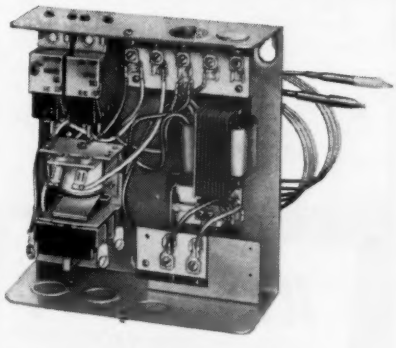
Edward R Searles
Editor

COOLING CENTER
controls the remote condensing unit. Internal circuits are factory-wired.

FAN CENTER
controls the air handling equipment on all systems with remote condensing units.

ALL-NEW! "CODED" CONTROL CENTERS

for residential air conditioning



SYSTEM CENTER
interlocks in one unit all heating-cooling functions for self-contained systems.

In Penn's newest line of Control Centers, field-replaceable parts are easy to get out . . . easy to get in *correctly* because all internal wiring is color coded. And, these color-coded leads are equipped with *quick-connect terminals* . . . no more looping of wire or soldering connections.

There are other advantages, too! Centers are small to save space in compact 2 and 3 H.P. units. Wrap-around cases save wiring time in factory and field. And, field-installed Fan Centers have Life Guard reverse panel construction. All operating parts are easily accessible, yet are fully protected against accidental damage. Write to the Penn factory for the complete story on these new, better Control Centers.

PENN CONTROLS, INC. Goshen, Indiana

EXPORT DIVISION: 27 E. 38th ST., NEW YORK, N.Y.

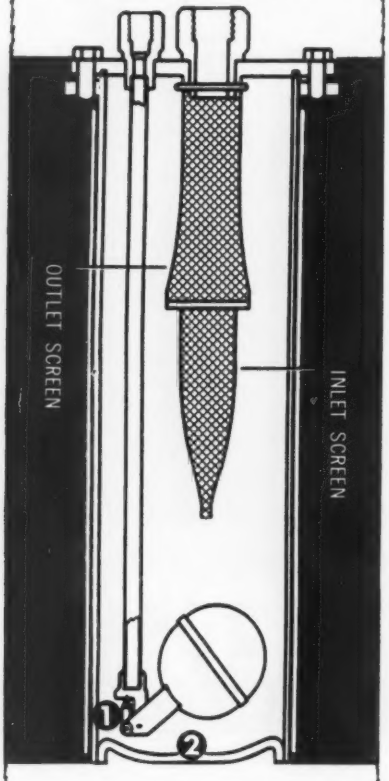
AUTOMATIC CONTROLS FOR HEATING, REFRIGERATION, AIR CONDITIONING, APPLIANCES, PUMPS, AIR COMPRESSORS, ENGINES

BOOST
REFRIGERATING
EFFICIENCY
AND MUFFLE SOUND
with a

TEMPRITE OIL SEPARATOR

Oil is separated from the gas before it can get into the evaporator and is returned to the compressor automatically . . .

- Full capacity of expansion valve assured.
- Evaporator heat transfer increased.
- Constant clean oil lengthens compressor life.
- TEMPRITE oil separator muffles sound.



1 OIL RETURN VALVE: Located ABOVE the sludge reservoir.

2 SLUDGE RESERVOIR: Traps sludge, oil carbon, and foreign substances, preventing their continued flow through the refrigerating system.

Complete range of capacities for refrigerants 12 and 22. ASME and UL approved.

8 PAGE BOOKLET ON REQUEST

Describes many advantages of Temprite Oil Separators.

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Birmingham, Mich.
Send me Oil Separator Booklet No. T-397

Name_____
Address_____
City_____ Zone_____ State_____

Now that you mention it—

A SECOND THOUGHT

To the Editor:

In a recent conference, representatives of Elof Hansson Inc. have presented us with data taken in their laboratories which show a much higher noise reduction for their units than was reported in my "How effective are packaged sound attenuators for air conditioning systems" as published in the February 1960 issue of the JOURNAL.

This discrepancy is sufficiently large that we feel it represents a major technical dispute which can be settled only by intercomparing the two test techniques. We have, accordingly, offered to repeat our tests on several units with their cooperation in our laboratories, and to repeat their tests on these units with our participation in their laboratories to ascertain where such a difference can arise.

The test program will be carried out as expeditiously as possible and you will be informed of the results upon its completion.

In fairness to your readers, we call this to your attention that they may be aware that a dispute exists over the data as published.

NORMAN DOELLING
Senior Consultant
Bolt Beranek and Newman
Cambridge, Mass.

WHO'S WHO IN ASHRAE

Insofar as possible, these listings will each appear twice a year

ASHRAE OFFICERS, COMMITTEES
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REGION AND CHAPTER OFFICERS
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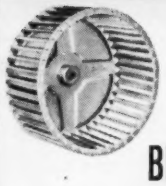
RESEARCH AND TECHNICAL COMMITTEES
See page 74, February JOURNAL

STANDARDS COMMITTEE
See page 89, November JOURNAL

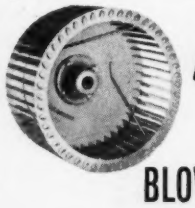
INTER-SOCIETY COMMITTEES
See page 66, February JOURNAL

AIR...
the delivery you need in the space you have!



Revcor "BLASTAIRE" BLOWER WHEELS

Single and double inlet in 22 dia. from $3\frac{27}{32}$" to 15"; widths 1" to 15". For maximum air and pressure in minimum space.



Revcor "R" DESIGN BLOWER WHEELS

For heavy duty applications in oil burners, industrial ovens, etc. Diameters $5\frac{1}{4}$" to $12\frac{5}{8}$". In steel, aluminum, stainless steel.

Revcor FAN BLADES

High efficiency propeller fans for every application. 8 types in diameters from 6" to 48".

Inlet Rings and Housings also Available

WRITE FOR FREE BROCHURE
or send specifications to:

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247 Edwards Street
Carpentersville, Ill.

Climate by Chrysler

Edison Lanes, Edison Township, N. J. Chrysler Air Conditioning Contractor: Nicholas W. Schwalje, Inc., Metuchen, N. J.

World's largest bowling lanes cooled by Chrysler Packaged Air Conditioning

Almost a quarter of a mile separates Lane No. 1 from Lane No. 112 at Edison Lanes, Edison Township, N. J. If a bowler ever made the trek, then Chrysler Packaged Air Conditioning units would be keeping him cool and comfortable every step of the way.

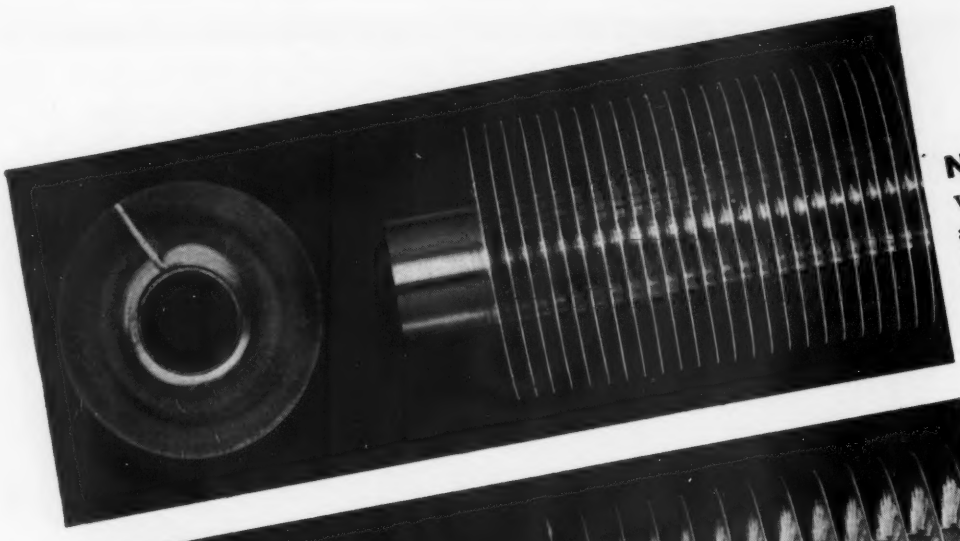
It takes 340 tons of air conditioning to cool bowlers behind the foul lines and in the service areas. Since it is not necessary to cool the lanes themselves, the diffusers and air returns are concentrated at the foul lines to create a "curtain wall" effect. This prevents cool air from spilling out of the conditioned areas.

The 20- and 30-ton Chrysler Air Conditioners are self-contained evaporative condenser units with dual compressors. They're specially arranged to provide zone control, so only the lanes in use need be cooled.

Chrysler equipment was selected for this job because it offered the owners the twin advantages of flexible installation and most economical operation. For more information, or the technical cooperation of a Chrysler air conditioning engineer, write today.

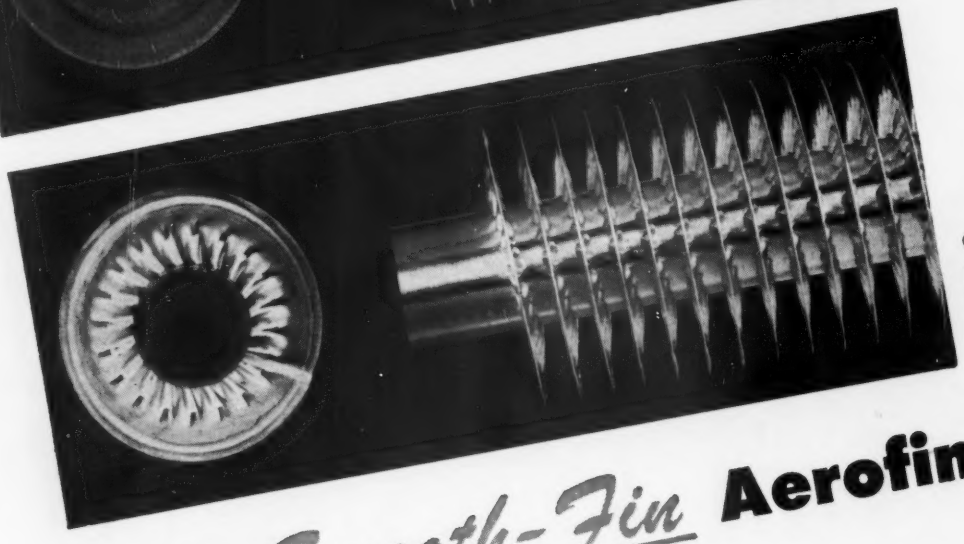
CHRYSLER
AIRTEMP

Airtemp Division, Chrysler Corporation, Dept. Z-50, Dayton 1, Ohio
In Canada: Therm-O-Rite Products, Ltd., Toronto, Ontario



New Smooth Fins

Wide base provides ample contact surface. Smooth fins can be closely spaced without increasing resistance.



Old Type Fins

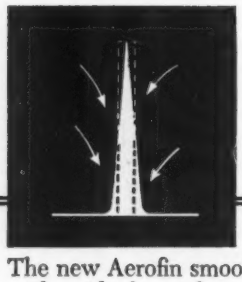
Crimped to provide necessary contact surface, widely spaced to reduce air friction.

NEW *Smooth-Fin* Aerofin Coils for Greater Capacity— Lower Resistance

Aerofin extended-surface heating and cooling coils now offer you an even greater area of effective surface — even greater capacity — per square foot of face area. Airway resistance is lowered; higher air velocities can be used. The result is extremely high heating or cooling capacity in a given space.

Compact, sturdy, standardized encased units arranged for simple, quick, economical installation.

Write for Bulletin S-55



The new Aerofin smooth fins are tapered, with wide base that conducts sufficient heat between fin and tube to make the entire fin effective transfer surface.

AEROFIN CORPORATION

101 Greenway Ave., Syracuse 3, N. Y.

Aerofin is sold only by manufacturers of fan system apparatus. List on request.

SERVICE UNLIMITED WITH EVERY ORDER. The customer is king with Bendix-Westinghouse. When you place an order for compressor or condensing unit equipment with us, we make your business our business. Our staff of engineers stands ready to give you any assistance you may desire in tailoring Bendix-Westinghouse installations to your individual requirements. And this service continues after the sale, too! Why not look over the facts on the back of this page and see how easily Bendix-Westinghouse can fit into your product plans.

Bendix-Westinghouse MOTOR COMPRESSORS

BENDIX-WESTINGHOUSE "OVAL-LINE" MOTOR COMPRESSORS PROVIDE GREATER EFFICIENCY... IN LESS SPACE...AT LOWER COST

Looking for compact ¼- or ⅓-h.p. motor compressor design that will let you provide more refrigeration space in standard-size cabinets?

Want a low-cost compressor with longer, more dependable operating life?

Anxious to find a compressor with greater operating efficiency?

The YCH25V-1 and the YCH33V-1 models in the Bendix-Westinghouse "Oval-Line" provide *all* these advantages. Their two-pole design makes possible lighter weight, smaller size, and lower cost. They also supply such superior performance features as: inherent overload protection, better motor insulation, full suction gas cooling, positive pressure lubrication and glass terminals.

If you use fractional horsepower motor compressors in your manufacture of beverage coolers, vending machines, water coolers, dehumidifiers, or other general commercial type cooling equipment, investigate the Bendix-Westinghouse "Oval-Line" compressors. Call or write direct.

Bendix-Westinghouse

EVANSVILLE, INDIANA

A Division of Bendix-Westinghouse Automotive Air Brake Company, Elyria, Ohio
Export Sales: Bendix International, 205 E. 42nd St., New York 17, N.Y.

Concerned with the comfort of a rapidly expanding summer audience, New York theatre impressario J. J. Shubert turned to the Worthington Corporation of New Jersey for a master air conditioning system to cool all seven of his famed Shubert Alley Theatres. Worthington engineers solved this intricate mass air conditioning problem by offering a 650-ton central refrigeration plant for installation in an abandoned boiler room beneath historic Shubert Alley. Chilled water is piped from this central plant to cooling units in each of the seven theatres. This unique hook-up serves a combined seating capacity of 7,999 warm-weather patrons, making it the largest single theatrical air conditioning installation ever devised.

SPECIFIED:
Ucon BRAND REFRIGERANT 11

Milestone or mainstay, whatever the unit on your drawing board, one of the five grades of dry, pure, top-quality Ucon Brand Refrigerants will charge it to perfection. What's more, through the Ucon Brand Refrigerants Technical Assistance program, your Ucon Refrigerants Representative offers you expert assistance on matters ranging from technology to refrigeration selection. Put him to work for *you...soon!*

UNION CARBIDE Ucon BRAND refrigerants

These 5 Ucon Brand Refrigerants will meet your refrigeration and air conditioning needs

- Ucon Refrigerant 11 Trichloromonofluoromethane
- Ucon Refrigerant 12 Dichlorodifluoromethane
- Ucon Refrigerant 22 Monochlorodifluoromethane
- Ucon Refrigerant 113 Trichlorotrifluoroethane
- Ucon Refrigerant 114 Dichlorotetrafluoroethane

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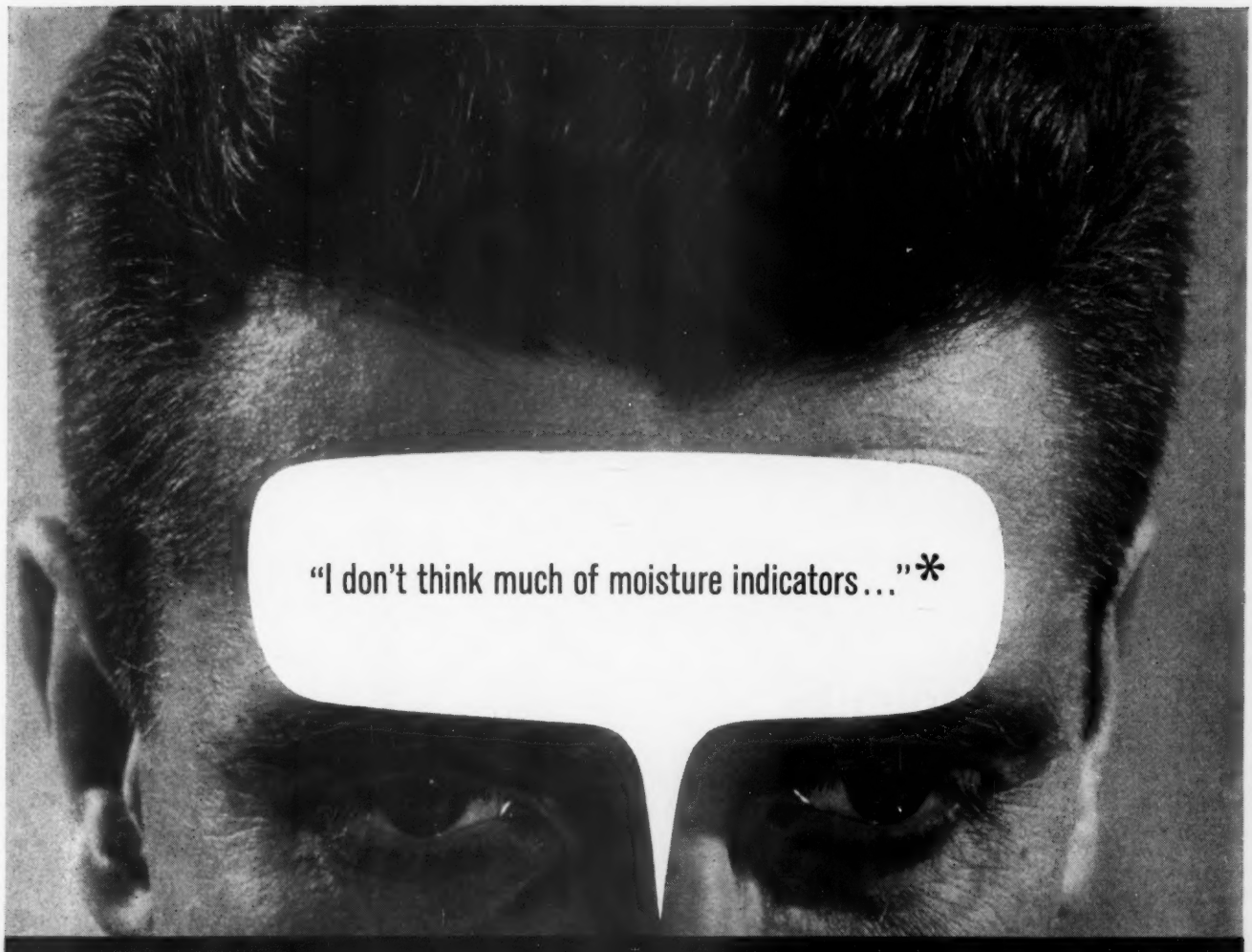
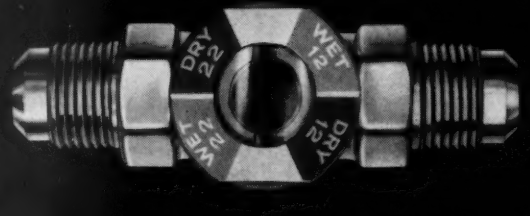
UNION CARBIDE CHEMICALS COMPANY—*Division of Union Carbide Corporation*

270 Park Avenue, New York 17, New York



*PERHAPS THAT'S BECAUSE YOU HAVEN'T TRIED ANSUL'S BRAND NEW "200" DRY-EYE, SIR! In this unique refrigeration service aid, the Refrigerant-12 indicator, the Refrigerant-22 element and the sight glass are combined in one unit which screws out easily, in one piece, to permit worry-free soldering of sweat connections. No jig-saw puzzles to put together when you have to remove the core of the unit . . . no possible way of damaging the elements during installation. ❙ Most moisture indicators are notoriously inaccurate in showing the moisture content of Refrigerant-22. Refrigerants vary markedly in their moisture characteristics and an R-12 indicator just won't do the job on 22. However, the "200" Dry-Eye has a separate, true Refrigerant-22 indicator—painstakingly designed to show scientifically the moisture content that signals danger in R-22 systems. ❙ "200" Dry-Eyes are available in all standard sizes, flare and sweat, in both the in-line models (L-200) and the popular T models (T-200). This latter, when attached to the Ansul T-Flo Drier, provides a complete moisture control system. See them now at your refrigeration wholesalers' or write directly to the Ansul Chemical Company for additional information.

ANSUL



ANSUL CHEMICAL COMPANY • MARINETTE, WISCONSIN | FIRE EXTINGUISHING EQUIPMENT • REFRIGERATION PRODUCTS • INDUSTRIAL CHEMICALS

When our friends are also our customers (and vice versa), that thousandth of an inch can be very important!

Leading makers of air conditioning and refrigeration equipment select Viking copper tube because of its strict standards of quality: absolutely true as to roundness, uniform as to wall thickness, exact as to diameter.

The reason lies in the fact that the mandrels and dies used to draw Viking copper tube are held within extremely limited tolerances. Special machinery built by Viking keeps a constant check on these limits.

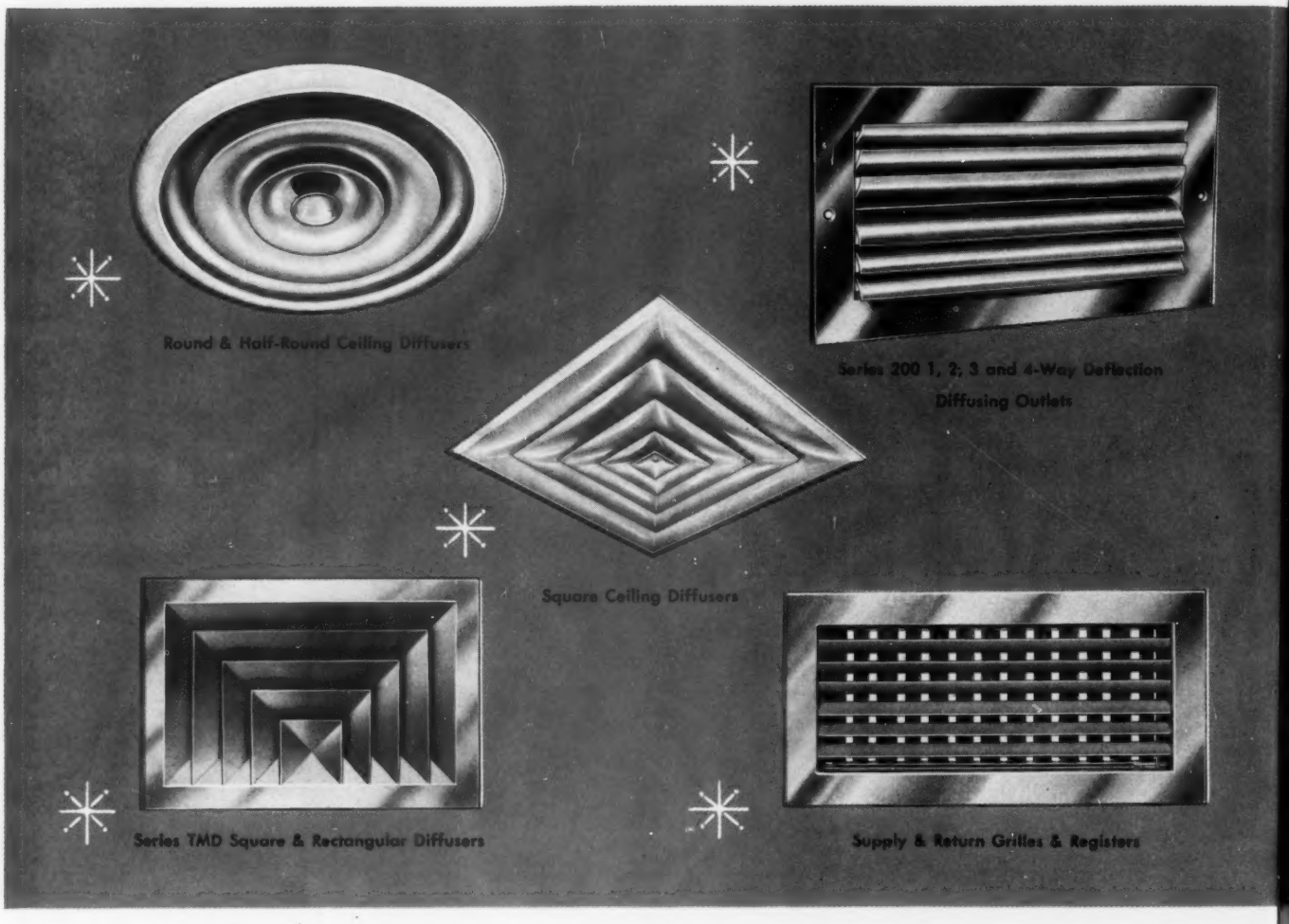
Attention to the smallest detail of fabrication produces thin-wall copper tube that is consistently superior in quality. Viking customers keep coming back — precisely because they know that to us even a *fraction* of a thousandth of an inch *does* make a difference.

VIKING

COPPER TUBE CO.

CLEVELAND 10, OHIO

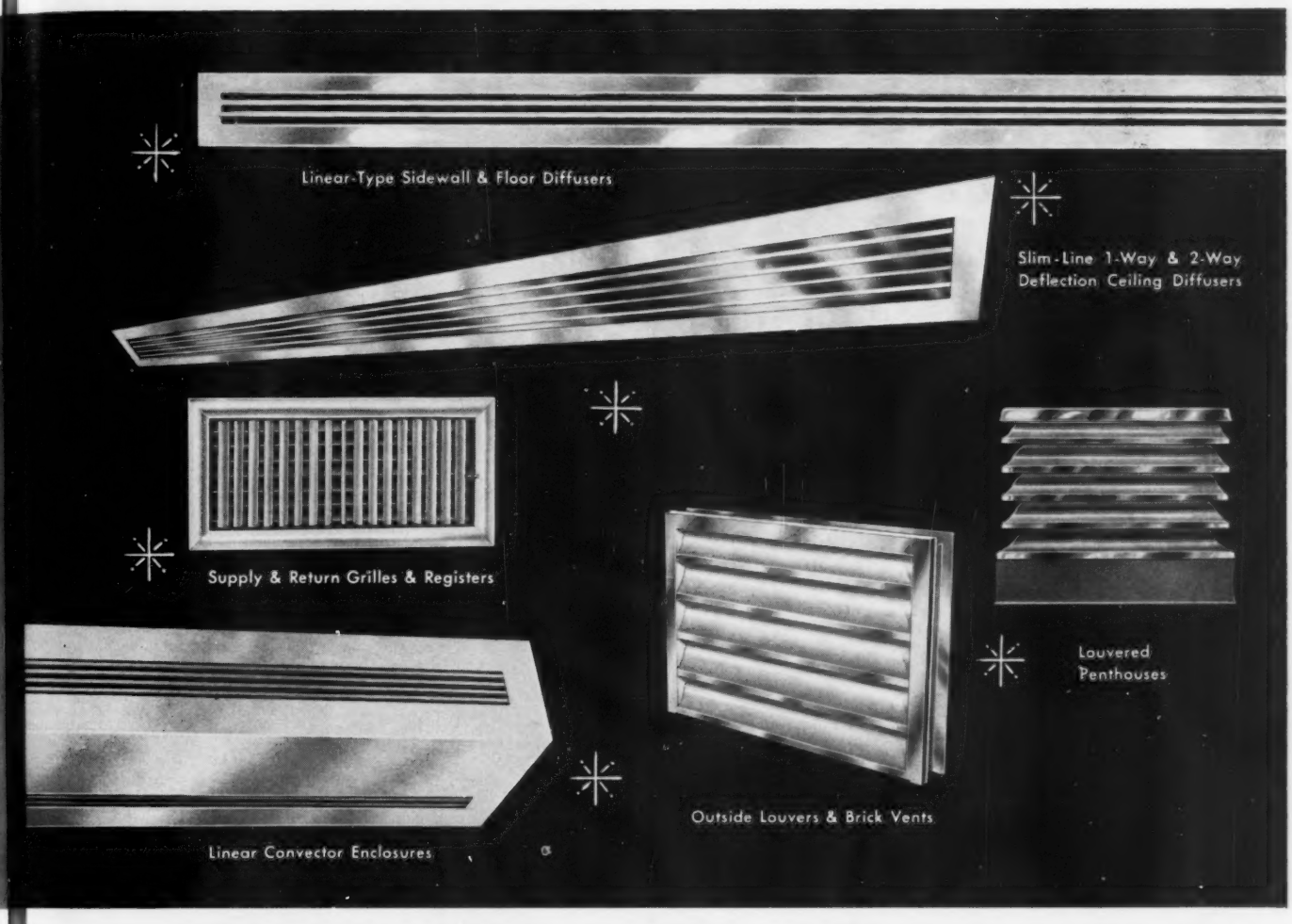
for outstanding design in the ***CONVENTIONAL*** . . .


Round & Half-Round Ceiling Diffusers
Series 200 1, 2, 3 and 4-Way Deflection Diffusing Outlets
Square Ceiling Diffusers
Series TMD Square & Rectangular Diffusers
Supply & Return Grilles & Registers

specify the one reliable, complete source . . . . . .

Whether you want the best in *CONVENTIONAL* air diffusion equipment . . . or the *SUPERB* in extruded aluminum . . . you can get it at TITUS! For Titus has just made air conditioning history. *Never before has anyone . . . anywhere offered such a large, complete line of quality grilles, registers and diffusers.* You really benefit when you specify from ONE RELIABLE, COMPLETE SOURCE. One source means one responsibility . . . faster, accurate delivery of orders. And Titus' large, complete line *eliminates any need to compromise in product selection.* You can select the *exact* outlet to fit the job . . . YOUR GUARANTEE OF THE MOST EFFICIENT AIR DIFFUSION. Titus extruded aluminum diffusers are made of the very finest aluminum extrusions *from Titus' own extrusion presses.* Titus also *custom makes* extruded aluminum diffusers, grilles and louvers to fit *any* specification. For full details, write: *Titus Custom Design Engineering Dep't,* or contact your nearest Titus representative.

. . . . . or the ***UNUSUAL*** in fabulous aluminum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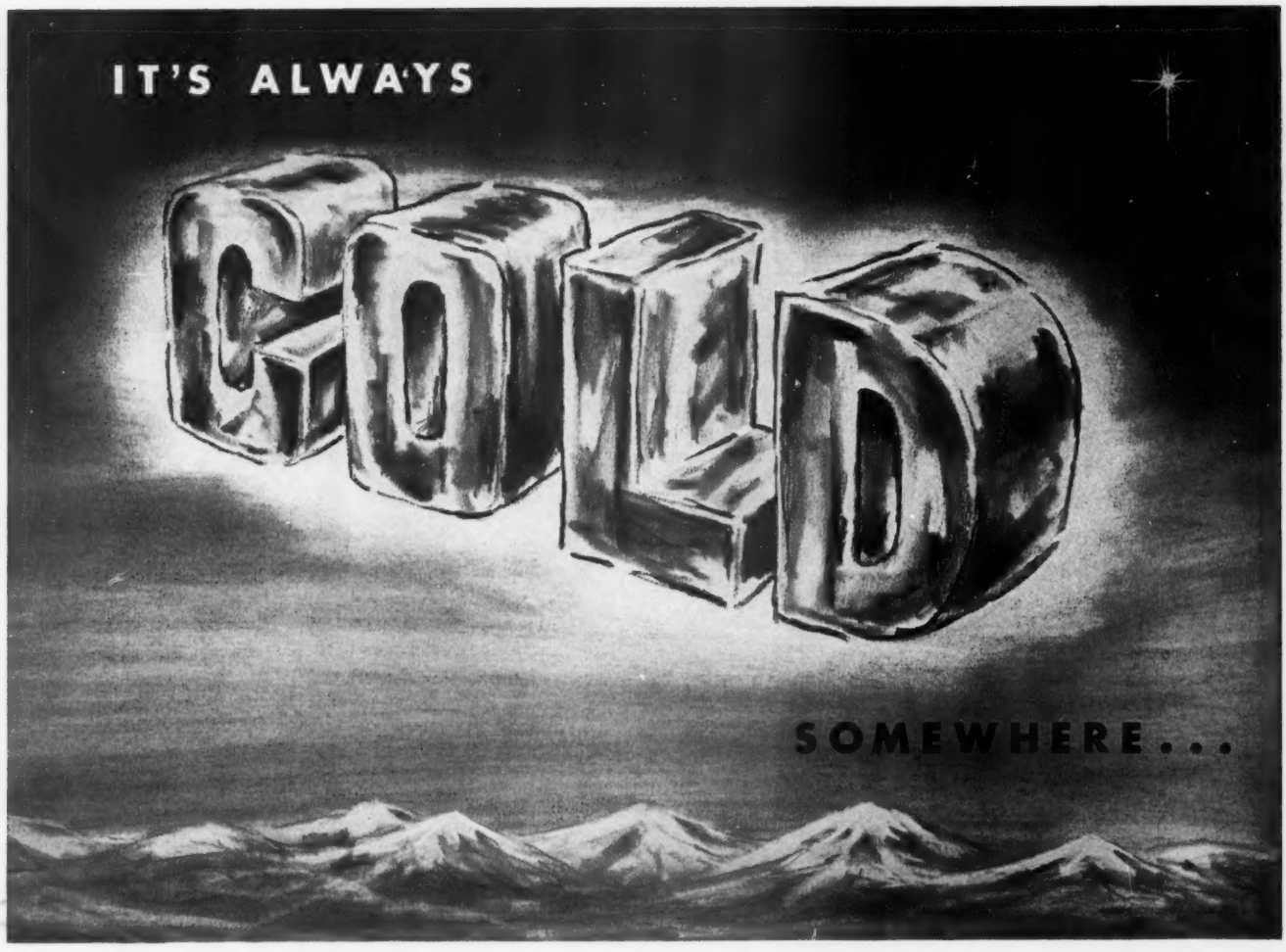

And SAFEWAY Heating Blankets and Elements solve cold problems wherever they exist!

Maybe it's a basic defrosting problem in industrial refrigeration . . . or perhaps it involves the vital protection of aircraft from the icy upper atmospheres.

For these and scores of in-between applications, Safeway provides a *controlled heat* product, regardless of environmental temperatures. And people who know refrigeration depend on Safeway Heat Elements as a completely reliable and economical solution to defrosting problems in the commercial and industrial field.

Safeway's modern manufacturing facilities are devoted *exclusively* to the design, engineering and application of *controlled heat* for industry. Among the wide variety of Safeway heating blankets, woven and molded heating elements are:

- **heating elements for launching equipment and for airborne gyros, cameras, computers, servos and batteries — for missiles or aircraft**
- **de-icing units for airfoil surfaces**
- **heating elements for all types of ground support equipment**
- **defrosting units for industrial and commercial refrigeration**
- **heating blankets for honeycomb and metal-to-metal bonding**

For your copy of a fact-filled folder, please write:

If it has to be heated (and the "it" can be just about anything), you can rely on SAFEWAY engineers to study your problems carefully, and—without any obligation—submit an appropriate recommendation.

Safeway HEAT ELEMENTS INC.

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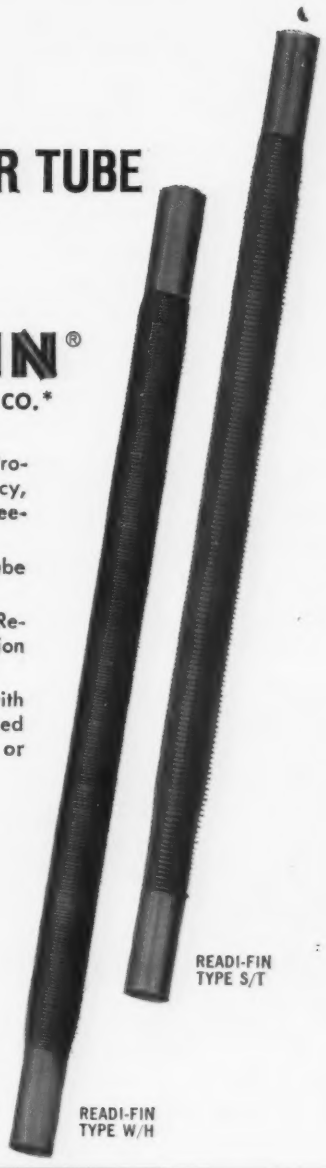

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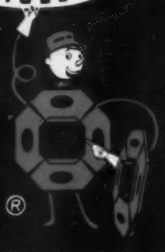

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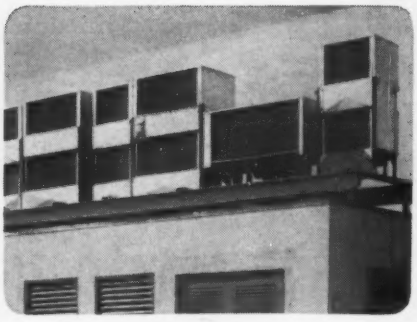
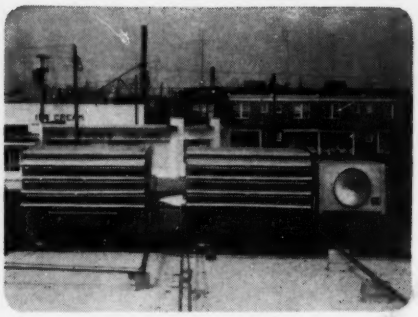
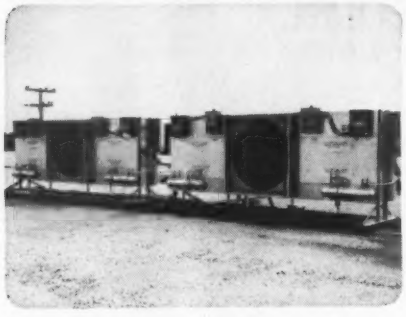
*throw your compressor out!**

*outside that is!

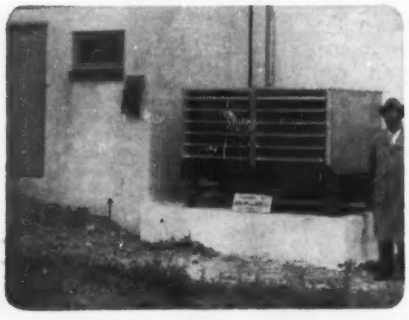


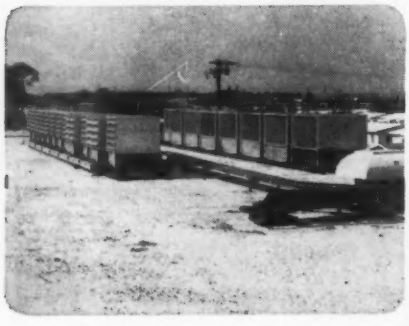


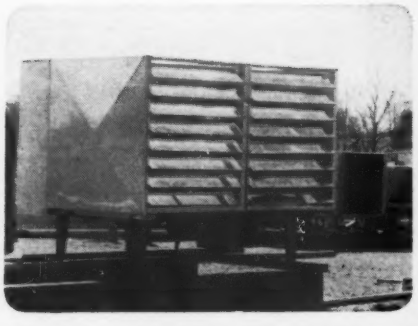


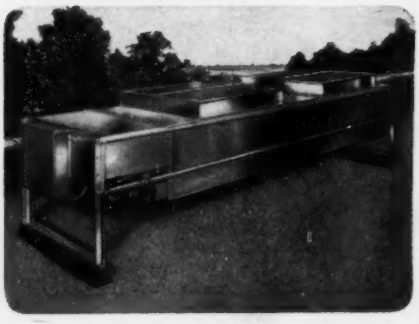
STOP

wasting costly building space!









USE KRAMER
OUTDOOR CONDENSING UNITS

FOR AIR CONDITIONING—COMMERCIAL, INDUSTRIAL & SUPERMARKET REFRIGERATION

Kramer's Outdoor Condensing Units will operate outside without any additional protection or adjustment under all temperatures and weather conditions. They can be used for any application —air conditioning, commercial refrigeration, supermarket application, or industrial refrigeration.

Completely assembled, wired, tested and factory run-in, the units arrive on the job ready to operate. Simple hookup eliminates costly installation and control adjustment time. Kramer's Outdoor Condensing Units end waste of valuable indoor space.

WRITE FOR BULLETIN

KRAMER TRENTON CO., Trenton 5, N. J.

47 YEARS OF CONTINUOUS ACHIEVEMENT IN HEAT TRANSFER

Quiet...

WAGNER Polyphase Resilient Mounted Motors in ratings through 10 horsepower

Quiet, vibration-free performance is essential when motors are installed in areas where noise must be held to a minimum . . . in hospitals, churches, schools, office buildings, restaurants and similar locations where quiet is needed or wanted.

Such installations have created a need for larger polyphase motors that whisper while they work. Wagner has met this need by expanding its line of polyphase resilient mounted motors to include standard ratings through 10 hp.

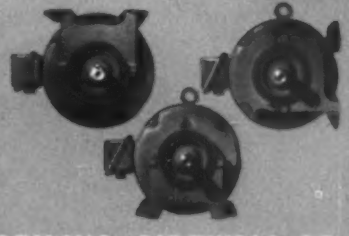
You certainly have applications that call for a smooth running motor, cushioned by resilient mountings. To make sure they're quiet, specify Wagner Polyphase Resilient Mounted Motors. Only Wagner can provide an entire range of ratings through 10 hp.

Constant research and development have kept Wagner up front in electric motor design for more than 65 years . . . made the name Wagner one you can depend on in choosing electric motor drives.

Your nearby Wagner Sales Engineer can help you select the right motor to meet your requirements. There are Wagner branch offices in 32 principal cities.

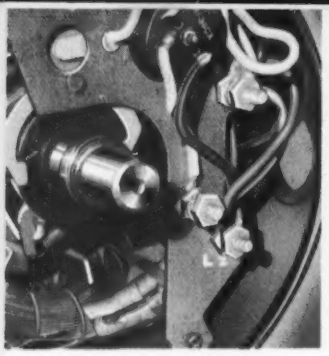
Wagner Electric Corporation
6400 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI

SLEEVE OR BALL BEARING.
These motors are furnished with quiet running steel-backed babbitt-lined sleeve bearings of high load carrying capacity. Ball bearings can be supplied when desired.

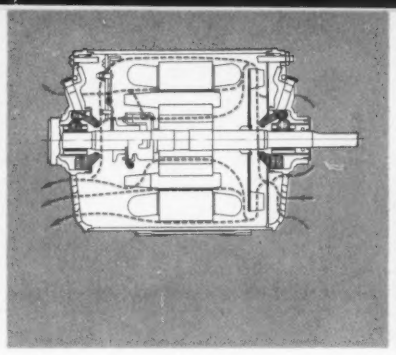


CEILING, SIDEWALL OR HORIZONTAL MOUNTING.
You can mount these motors on walls or ceilings by rotating the cradle base 90° or 180°. Motor stays dripproof.

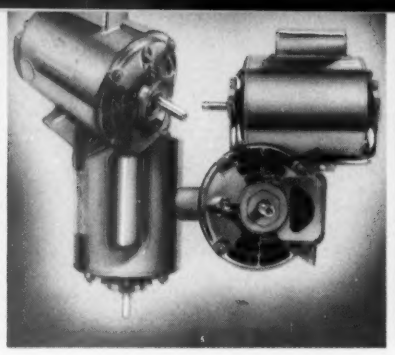
NEOPRENE CUSHIONING RING.
Annular mountings, of oil-resistant neoprene bonded to steel rings, cushion the motor in its cradle base to absorb the small amount of vibration that remains in the most carefully balanced motor.



Quick Break Switch. The starting winding is disconnected from the line by this Wagner designed switch . . . test proved to make more than a million breaks. (That adds up to two starts per hour for 50 years!)



Efficient Cooling System. The improved ventilating system used in these motors directs a large volume of air through the motor to effectively reduce temperatures and add to motor life. Cross section indicates direction of air flow.



All-Angle Operation. The sleeve bearing design, in fractional hp ratings, has a positive lubrication system that permits operation in any position . . . can mean important savings in motor costs to manufacturers.

Quick Connect Terminals. Brass tabs on terminal studs permit quick, easy connection of leads . . . cut wiring time to speed assembly line production. Simply press the lead receptacle on to the stud—a positive connection is assured.

NO STARTING PROBLEMS with WAGNER CAPACITOR-START MOTORS

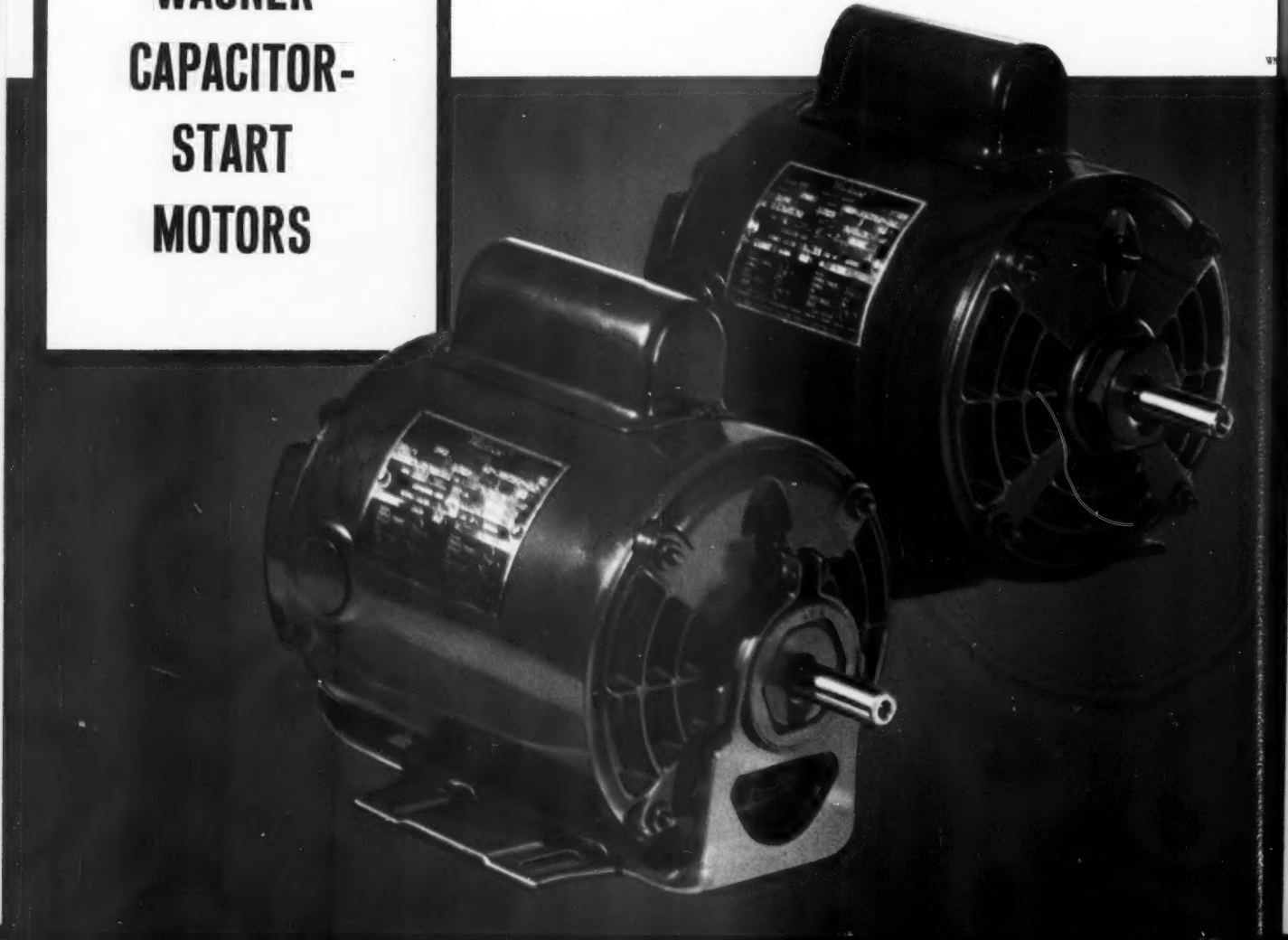
Pack more power into less space...give long troublefree service...are easy to hook up

Here are general purpose single-phase motors that have high starting torque and high pull-in torque. When used in the proper application and supplied with voltage close to their rating, they'll give positive starts every time. Troublefree operation is assured . . . thanks to the positive action of the Wagner governor mechanism and long life quick-break switch.

Wagner Type RK Motors pack more power into less space. Small enough to fit in tight spots, their ruggedness is built-in . . . permits direct mounting. And, sleeve bearing fhp models can be operated in any position. They are available in a range from 1/6 through 5 horsepower, with sleeve or ball bearings, and with rigid bases or resilient mountings.

Get these motors from leading motor distributors in your city, or from Wagner sales offices in 32 cities across the country. Your Wagner Sales Engineer will be glad to help you select the right motor for your application. Wagner Bulletin MU-217 gives full details on Capacitor-Start Motors.

Wagner Electric Corporation
6400 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI



Late news highlights

EJC There were several changes in personnel at Engineers Joint Council recently. Dr. George E. Holbrook has been elected vice president of EJC, succeeding Cecil Boling who has resigned; L. K. Wheelock has been selected secretary of EJC, succeeding E. Paul Lange; and Mr. Lange becomes Executive Secretary of the American Institute of Industrial Engineers.

Engineering Index A guide to periodic technical literature, the Engineering Index consists of annotated reference items which provide a comprehensive digest of important information on technical, scientific and economic problems as recorded last year in engineering magazines, special bulletins and government reports gathered from all over the world. The forthcoming Annual Edition (1959) will contain annotations on over 30,000 articles in 249 fields of engineering interest. Advance orders for this volume, which will be ready for distribution in June, are now being accepted by the Engineering Index, 29 West 39th Street, New York 18, N. Y.

Society sponsored Close to 400 exhibitors have already reserved space for the 15th International Heating and Air Conditioning Exposition, a biennial event sponsored by ASHRAE and to be held concurrently with its Semiannual Meeting, February 13-16, 1961 in Chicago, Ill.

Oil-burning review American Petroleum Institute has made available a 110-page review consisting of some 300 abstracts of technical literature relating to residential oil burning. Prepared for API by combustion technologists under the direction of David W. Locklin and Carl F. Speich at the Battelle Memorial Institute, this publication is designed to provide a guide to technical literature, relating particularly to distillate fuel-oil combustion for residential heating equipment and similar low-capacity oil-fired applications. Copies of this review, "Literature Pertaining to the Art and Science of Oil Burning for Residential Applications," API Publication No. 1537, is available free of charge from the Division of Marketing, API, 1271 Avenue of the Americas, New York 20, N. Y.

Pan American meetings Buenos Aires, Argentina will be the site for two engineering meetings this September—Pan American Congress on Engineering Education (September 12-16) and the Seventh Convention of the Pan American Association of Engineering Societies (September 19-23).

BRI fund Establishment of a new Building Science Education Fund, to be used for a program to encourage creative people to pursue building research activities in colleges and universities, has been announced by the Board of Governors of the Building Research Institute, 2101 Constitution Avenue, Washington 25, D. C.

Summer seminar A seminar on Design Engineering for personnel engaged in development and product and systems design, which is designed to stimulate imaginative and creative thought in design engineering and also to develop methods and procedures in synthesis applicable to design projects, will be held at Pennsylvania State University, University Park, Pa., June 12-17.

Liquid nitrogen process A new method of retaining sub-zero temperatures during a cross-continent shipment on a railroad car, without any mechanical refrigeration, was used recently in transporting 61,000 lb of frozen food from California to New York. By this process, frozen food was subjected to liquid nitrogen and brought down to −320 F at California; average temperature of the car of food on arrival in New York, seven days later, was −124 F.

Teachers' salaries In its report upon "Salaries Paid and Salary Practices in Universities, Colleges and Junior Colleges" covering returns from 1312 institutions with full-time enrollments totalling 1,973,070 students, the Research Division of the National Education Association indicates that there has been a two-year increase of approximately 12% in salaries paid to teachers in all types of institutions. Median salary paid is $6711-6906 for men and $5865 for women. As reported in Engineering and Scientific Manpower Newsletter #125, March 29, 1960, municipal universities as a group lead all other types of institutions by a wide margin in the median salary paid, whereas it is stated that private colleges fall behind the rest.

Electric precipitation Pennsylvania State University's annual Electric Precipitation Seminar, designed for engineers in the public utilities and the cement industry, as well as for other industries concerned with the installation of electric precipitation equipment, will be held at the University, University Park, Pa., June 14-19. Topics to be covered include a discussion of air cleaning for air conditioning and air pollution control.

Growing market With 850,000 homes reported as being electrically heated today and a goal of 6,000,000 set for the close of this decade, the electric heating market in terms of equipment and labor will soon reach $1 billion annually, predicted C. F. Kreiser, Chairman of the Nema Electric House Heating Equipment Section, speaking at its recent First National Electric House Heating Symposium and Exposition, held March 21-23, in Chicago, Ill.

ARI estimate Installed cost of central station air-conditioning systems which went into operation in large multi-room buildings and commercial and industrial applications in the United States during 1959 has been estimated at $715,080,000 by the Air Conditioning and Refrigeration Institute; this compares with $604,-130,000 in 1958. ARI figures are based on shipments for use in the U. S. of compressors, condensing units, absorption systems and centrifugal and reciprocating liquid-chilling packages of 25 hp or over. Figures for brine chillers or equipment utilizing ammonia as the refrigerant are not included.

Transfer by pipeline Results of a recent theoretical study undertaken at the Cryogenic Engineering Laboratory, Boulder, Colo., indicate that the pipeline method, now employed only in relatively short-distance transfer of liquefied gases, can be extended to appreciable distances provided there is an awareness of the performance limitations introduced by undesirable cool-down characteristics. As reported in National Bureau of Standards Summary Technical Report, STR-2468, April 1960, "Transferring Liquefied Gases by Pipeline," this study not only provides the theory for designing long-distance pipeline systems for low-temperature operation, but also gives information required for numerical computation.

APCA meets 53rd Annual Meeting of the Air Pollution Control Association will take place in Cincinnati, Ohio, May 22-26. Seven sessions covering virtually all phases of this problem have been scheduled.

ASHRAE ROSTER—Now available, to members only however, the ASHRAE Membership Roster provides a complete listing of all members and shows names, membership grade and mailing address. Also included are tabular breakdown of membership by grades and listings of past presidents of ASHRAE and of precedent ASHAE and ASRE. Price $1.75 when order is accompanied by check or money order. Address ASHRAE Membership Div., 62 Worth Street, New York 13, N. Y.

* one way to solve your problems is with . . .

Important Information Available!

Lennox Industries Inc., Dept. 1-4
Marshalltown, Iowa

Gentlemen:

I am interested in the items checked below. Please mail complete information to me on . . .

- ☐ Direct-fired industrial heaters
- ☐ Unit heaters
- ☐ Gas Duct heaters
- ☐ LENNOX APPLICATION MANUAL (Industrial direct-fired space heaters)
- ☐ Have a LENNOX representative call

Name_____

Address_____

City_____ Zone____ State____

Important Information Available!

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 53 MARSHALLTOWN, IOWA

LENNOX INDUSTRIES INC.
DEPT. 1-456
MARSHALLTOWN, IOWA

Postage Will Be Paid by Addressee

Unit heaters

These unit heaters are ideal for supplementary heating such as heating loading dock and storage areas. They range in size from 80,000 to 250,000 Btuh.

GSDI duct heater

The GSDI duct heater can be used with existing duct systems as added heat or can be used as a forced air space heater when connected to a blower. Available from 120,000 to 420,000 Btuh.

"Landmark"

The Lennox "Landmark" is extremely versatile, because of its modular design. Ideal for heating and cooling smaller areas or, if used as multiple units, capable of handling larger areas. Air conditioning is an integral part of the Landmark system.

Lennox oil "Stowaway"

Where space is at a premium and capacity demands not too great, the Lennox Oil "Stowaway" line is an ideal solution. These units range in size from 119,000 through 350,000 Btuh.

OG4 industrial heaters

Here is the "big boy" of the Lennox line...the OG4 combination gas-oil industrial heater. Lennox industrial heaters have a range from 280,000 through 2,000,000 Btuh. Lennox industrial heaters can be installed either vertically, horizontally or inverted.

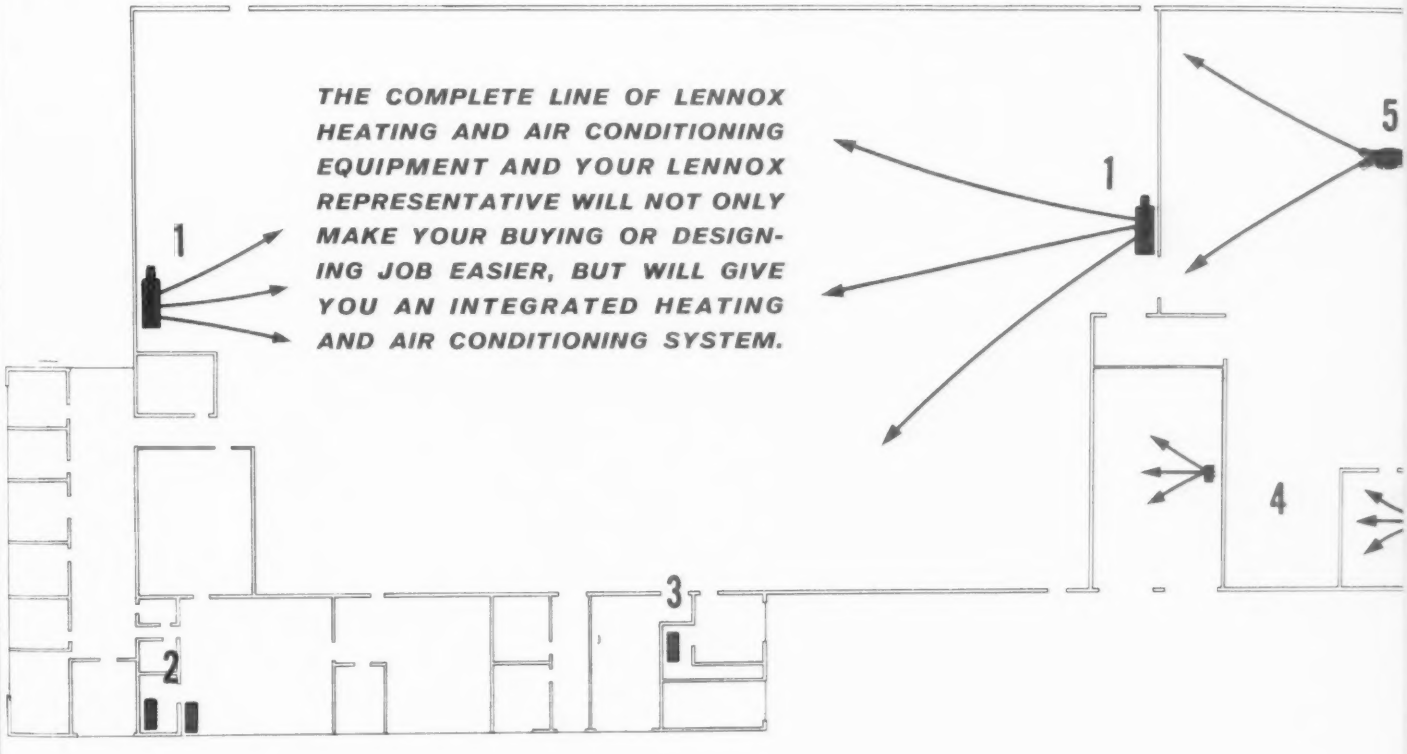
Air conditioning

Lennox Air Conditioning has been designed to work as an integrated part of the various heating units. Seventeen-ton condenser shown here is but one of the many units in the extensive Lennox line of air conditioning equipment.

These are just a few of over four hundred units in the extensive Lennox line of heating and cooling equipment.

There's no guess work or "make do" with Lennox equipment . . . This broad line of equipment meets every heating and air conditioning requirement. In the New York plant shown here, for instance, several types of heating and cooling problems faced the engineers. Each area in the plant had its own heating and cooling peculiarities and needs. By utilizing several types of Lennox models, each problem was solved easily. The results: properly sized units that deliver top heating and cooling at a sensible cost.

- direct-fired vs 'wet' industrial heating
- * heating and air conditioning
- make-up air and ventilation
- process work
- space heating


THE COMPLETE LINE OF LENNOX HEATING AND AIR CONDITIONING EQUIPMENT AND YOUR LENNOX REPRESENTATIVE WILL NOT ONLY MAKE YOUR BUYING OR DESIGNING JOB EASIER, BUT WILL GIVE YOU AN INTEGRATED HEATING AND AIR CONDITIONING SYSTEM.
1
1
2
3
4
5

(1) Two Lennox OG4 Industrial Heaters, delivering a total of 1,260,000 Btuh, heat 10,600 sq. ft. of manufacturing area. Although air nozzles are installed here, ductwork can also be used if the job conditions require it.

(2) Two Lennox "Landmark" heating and cooling units supplying a total of 238,000 Btuh, 12 tons of cooling maintain year around comfort in 4,800 sq. ft. of office area. Supply ducts are located in concrete slab with outlets at perimeter.

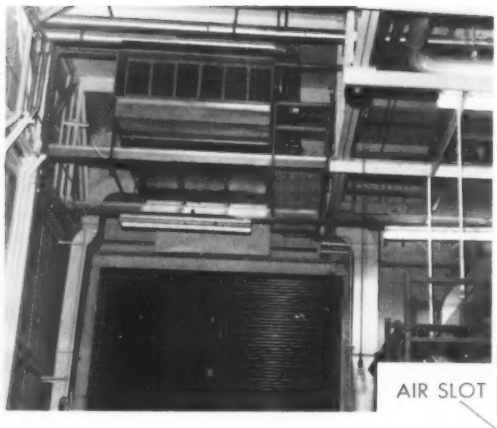
(3) A third Lennox "Landmark" unit heats remote supply and mailing areas.

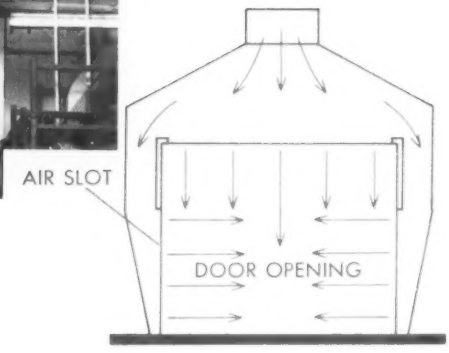
(4) Two Lennox gas heaters add supplemental heating to loading and storage areas.

(5) Single Lennox gas duct heater with a Lennox packaged blower suspended from the ceiling heats 7,000 sq. ft. with 420,000 Btuh. Cooling may be added if desired.

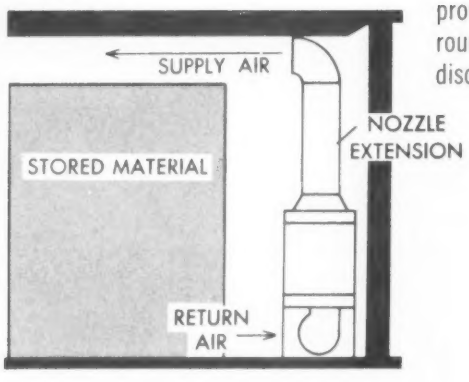
LENNOX

industrial heating and cooling equipment

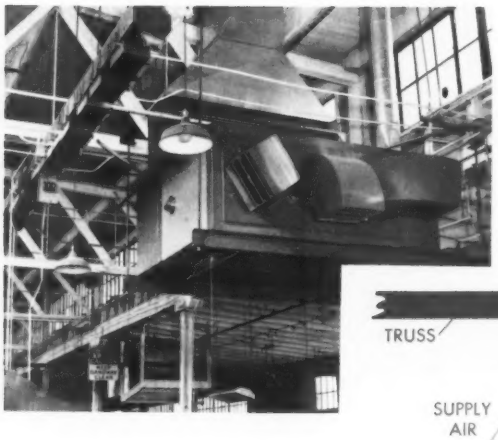


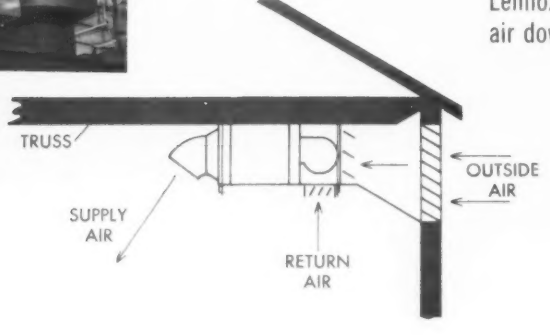


A problem frequently encountered in industrial heating is the infiltration of cold outside air into a heated space through large loading doors that are in frequent use. The most successful method of preventing the entrance of this cold air into the heated space is to surround the doorway with slot openings through which heated air is discharged at a velocity sufficient to blanket the opening. Note the line drawing and picture illustration of this method of heating.



Another problem encountered in various plants and warehouses are buildings used for storing materials. The volume of stored material leaves only aisleways and clearance from the pile to the roof line to circulate heated air. A simple and inexpensive solution to this problem is to provide air nozzle extensions which are simply round pipes that elevate the heated air stream discharge above the height of the stored material.





If floor space is unobtainable for the location of direct-fired space heaters, the next best thing is to suspend the units from the ceiling.

Lennox industrial heaters are available with service platforms for suspension purposes.

Lennox blowers are sized to push the heated air down to the work area where it belongs.

LENNOX Industries Inc.

MARSHALLTOWN, IOWA • COLUMBUS, OHIO • SYRACUSE, N.Y. • FORT WORTH, TEXAS • LOS ANGELES, CALIF. • SALT LAKE CITY, UTAH
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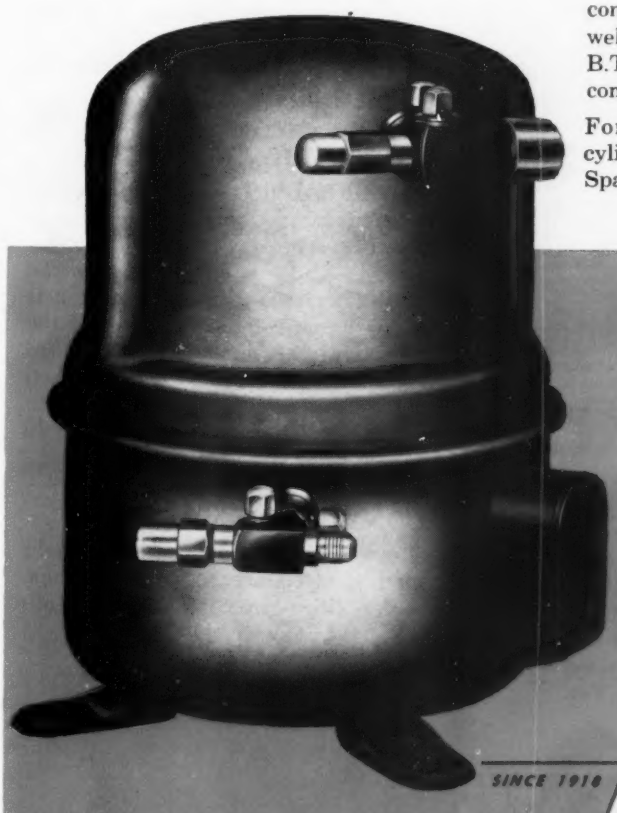
LITHO U. S. A.

FORM NO. IND.-602-M2

for quiet, compact packaged air conditioners, Copeland has what it takes!

Welded hermetics, 2½, 3, 3½, and 4 H.P. • • • 1750 R.P.M. • • • 4-pole • • • 4-cylinder • • • minimum space requirements • • • internal spring mounting for quiet, vibration-free operation • • • inherent motor-protector internally mounted, hermetically sealed • • • rotalock service valves rotate 360° • • • statically and dynamically balanced crankshaft • • • positive displacement gear oil pump, automatic reversing • • • heavy duty motor

NEW COPELAWELD welded hermetics pack more value into packaged air conditioners



Put "plus performance" into your packaged air conditioners with these four-cylinder Copelaweld welded hermetic motor-compressors. You'll get top B.T.U. capacity and operating dependability. For complete specifications, request Bulletin 5909.

For smaller sizes, investigate Copelaweld two-cylinder models, ½ through 2 H.P., and Copelaweld Space Savers, ⅛ through ⅓ H.P.

PERFORMANCE DATA

Model	Capacity* B.T.U./Hr.	Full Load Amps.	Locked Rotor Amps.
4U16-252	29,400	13.6	70
4U18-302	32,800	17.9	70
4U22-352	39,400	21.4	126
4U26-402	45,000	27.8	126

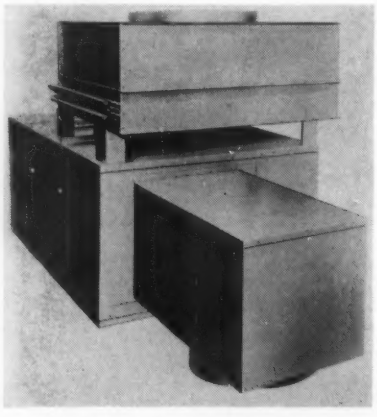
*Capacity based on A.S.R.E. rating conditions: Evaporating Temperature 45° F.; Condensing Temperature 130° F. Suction Gas Temperature 65° F.; No liquid sub-cooling.

SINCE 1916 **Copeland** REFRIGERATION CORPORATION, Sidney, Ohio

PARTS and PRODUCTS

TEN-TON ROOF UNIT

Roof-mounted and air-cooled, this ten-ton packaged air conditioner and gas-fired heater combination offers a complete year-round system for commer-



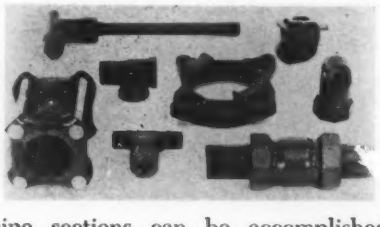
cial and industrial buildings. Suitable for one-story structures requiring a simple, economically installed heating and cooling system, the unit consists of a cooling system, gas-fired heating unit, air filters, blowers and controls. All internal piping and wiring is done at the factory. An air distribution plenum and diffuser, to carry air to and from the building interior, is supplied with the package.

Intake and discharge connections are through the end, permitting placement of the unit over weight-bearing building members not necessarily over the space it serves and running ductwork to the diffuser. Lift up, drop out access panels afford convenience in servicing the unit.

Typhoon Air Conditioning Div, Hupp Corporation, 505 Carroll St., Brooklyn 15, N. Y.

EPOXY RESIN COATING

Applied more easily and quickly than conventional mill coatings, this epoxy resin pipe coating in one-part powder form cures in less than 20 sec with close coating tolerances. Welding of



pipe sections can be accomplished through coating, once an arc has been struck on a bared spot.

Designated Scotchkote No. 101, the resin, upon application, is completely thermoset and will not flow under pressure nor upon heating. It has an adhesion strength of 3000 psi and high impact strength. Mill application of the coating is a four-step process consisting of cleaning, heating, coating and jeeping the pipe. In addition to major use as a pipe protection coating, it can be applied to fittings, meter brackets, transformer cases, beams, supports and other related objects.

Minnesota Mining and Manufacturing Company, 900 Bush Ave., St. Paul 6, Minn.

VENTED WALL HEATERS

AGA approved for use on both LP and natural gas, heaters in this line have a rated input of 35,000 Btu. Construction features include a sealed combustion system, forward flow discharge louvers, cast iron burners, a

200 cfm counter-flow blower and either a self-contained or wall thermostat.

"Sealed Flow" design permits installation of the heater on an outside wall, air for combustion being brought in through a sealed vent and combustion gases returned to the outside through the same vent assembly.

Dearborn Stove Company, 1700 W. Commerce, Dallas 22, Tex.

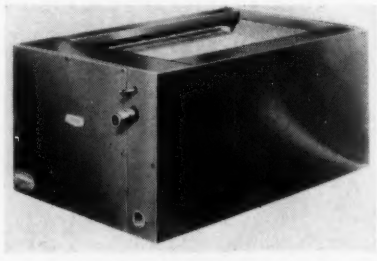
THERMOMETERS

For measuring temperatures of hot and cold water lines, heater coils and similar processing and refinery equipment, these thermometers are designed for use on refrigeration systems, hot water tanks and generators, oil burner pre-heating coils and other commercial and industrial circulating and storage systems. One-half-in. NPT brass separable sockets are provided for easy installation and unit replacement and a 2-in. brass extension neck socket is offered for insulated lines. Thermometer cases are available in straight, regular angle or oblique form. There is a choice of two temperature ranges: —40 to 110 and 30 to 240 F.

H. O. Trerice Company, 1420 W. Lafayette, Detroit 16, Mich.

DOWN-FLOW COOLING COIL

New to this line is a nominal two-ton coil designed to be installed under a



down-flow furnace. According to the manufacturer, the coil's cabinet is sturdy enough to support the weight of the furnace and is well insulated to prevent sweating and to hush air noise. Expansion valve and condensate eliminator are integral parts of the unit. Coil fins have a rippled edge.

Lennox Industries, Inc., Marshalltown, Iowa.

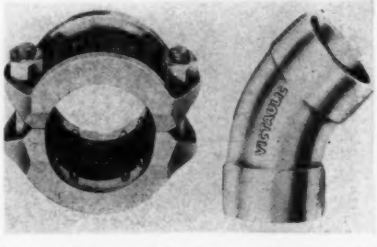
SOOT REMOVER

Applied to boilers with an industrial sprayer, Liquid Soot-Ban adheres to soot on vertical as well as horizontal surfaces and can easily be sprayed into difficult to reach areas. It acts to lower the combustion point of the carbon to the point where it burns away rapidly, but not violently, when ignited.

Parke-Hill Chemical Corporation, 29 Bertel Ave., Mount Vernon, N. Y.

CONNECTION METHOD

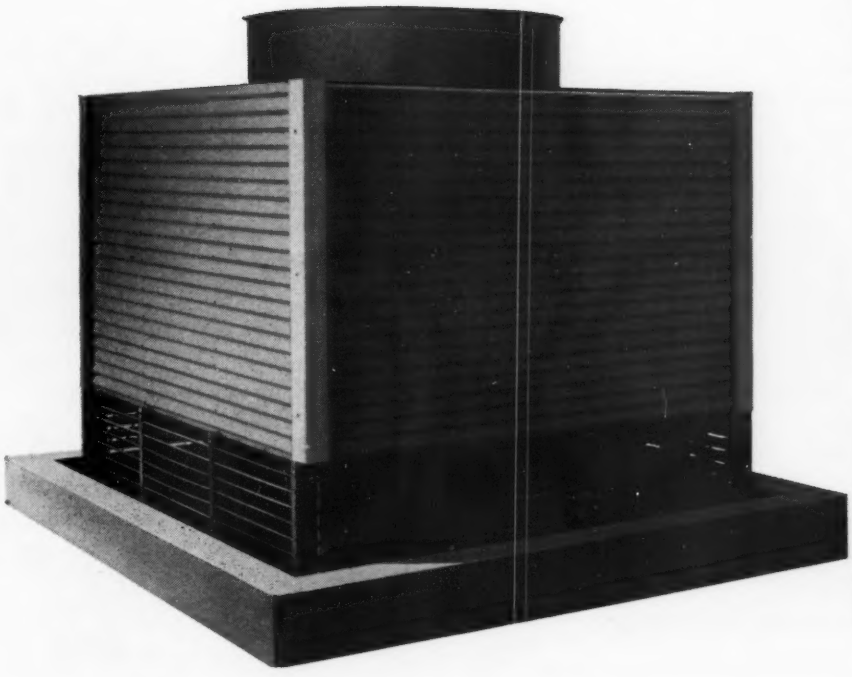
To afford a simple and leak-tight method of connecting plain end pipe with positive-grip couplings and "Full-



Flow" fittings, this manufacturer has developed the Plainlock Method.

Plainlock couplings are designed with two bolts for fast installation and are fitted with hardened stainless steel

FLUOR COOLING TOWERS



higher thermal performance

lower maintenance cost

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grips that engage the pipe ends and lock them securely together. Use of "Triple-Seal" gaskets assures leak-tightness.

Plain fittings are provided also as part of this package method. Engineered with long radii "Full-Flow" sweeps for good hydraulics and min friction loss, they are available with plain ends or in combination of plain and grooved, threaded or flanged ends for interconnection with other piping systems. Couplings and fittings are available in sizes 1, 2, 2½, 3, 4 and 6-in.

Victaulic Company of America, P. O. Box 509, Elizabeth, N. J.

THIN CEILING HEATER

Only two-in. deep, the C-209 Zonemaster can be surface mounted on non-combustible ceilings or suspended from standard ceilings, utilizes a flat quartz element and requires no fans or reflectors.

Application is primarily in hard-to-heat and exposed areas such as patios, garages, industrial plants and outside porches, where, when used there, it is cited as minimizing movement of air and dust. From a height of eight to ten ft, it will heat an area of approximately 125 sq ft.

Ratings are: Model C-209, 2000 watt; C-209-3, 3000 watt; 240 volt with 208 or 440 volt available.

Ampere Industries, 60 Boston St., Newark 3, N. J.

REFRIGERATOR-FREEZER

Glide-out center drawer and four separate temperature storage zones are features of this combination re-

frigerator-freezer. The center drawer, which can be opened without opening any other portion of the appliance, has two compartments: low temperature meat keeper and vegetable crisper. These special storage areas are cooled by means of a Cold Injector system. Air is drawn over a cold plate and forced into the area by a circulating fan, operating continually unless the door or drawer is open.

Upper portion of the unit is a refrigerator with glide-out shelves and an egg storage drawer that can be placed anywhere desired. Beneath the center drawer is a separate home freezer. Unit is frost-free.

Westinghouse Electric Corporation, P. O. Box 2099, Pittsburgh 30, Pa.

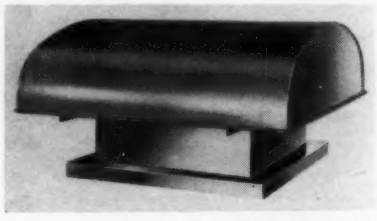
WALL-VENT HEATER

Featured in this 22,000 to 30,000 Btu, direct wall-vent, sealed combustion heater is an "Efficiency Guard" vent, which is both water and windproof. Simplified installation requires only one hole through the wall, while a telescoping vent adjusts to any wall thickness from five to 24 in.

Williams Furnace Company, 14960 Firestone Blvd., Buena Park, Calif.

MULTI-USE VENTILATOR

Multiple applications such as relief, gravity intake, power exhaust and



power supply are offered for Transaire low silhouette roof ventilators. Powered units are available belt-driven or with service-free direct drive.

Western Engineering & Manufacturing Company, 4114 Glencoe Ave., Venice, Calif.

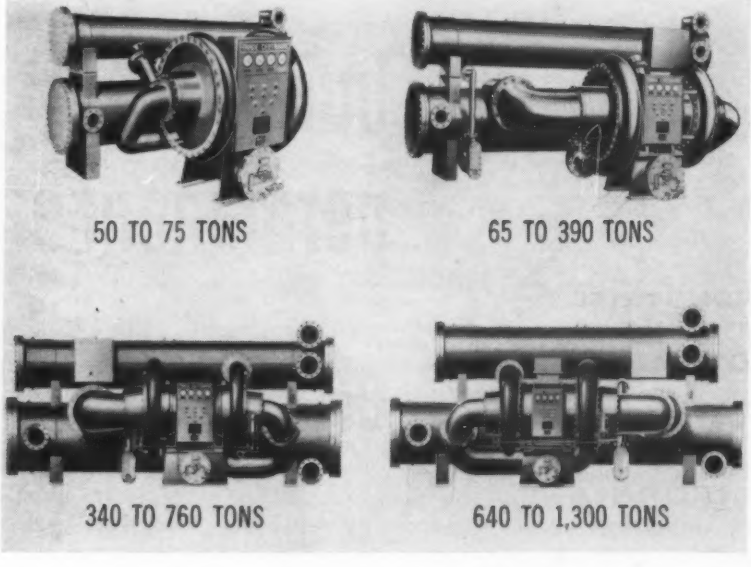
HERMETIC CENTRIFUGAL WATER CHILLER LINE

Selection of equipment for water chilling applications is now possible from more than 150 CanTraVac motor-compressor-shell combinations available in this expanded line

Two-stage balanced thrust design is utilized in the CenTraVac line, with pre-rotation capacity control ahead of each compressor stage. Driving the compressor is a constant-speed squirrel cage electric motor, operating in the refrigerant atmosphere. There are no shaft seals to be maintained or to leak refrigerant.

Evaporators and condensers have been redesigned with reductions in shell diam, thus reducing overall height of the unit. Through rearrangement of heat transfer surface, improvement in heat transfer coefficients has been achieved. New features include integral, fabricated water boxes for higher impact strength, improved connection flexibility and less leakage; and a control panel providing pilot lights for each of the safety controls.

Trane Company, La Crosse, Wisc.



REFRIGERATED CENTRIFUGE

In addition to spinning a capacity of 1500 milliliter at 60,000 x G and 3300 milliliter at 33,000 x G, this vacuum-type, refrigerated centrifuge interchangeably accommodates and spins smaller rotors with 400 and 360 milliliter at forces up to 51,000 x G.

Designated Vacu-Fuge, Model VA-2 features automatic rotor acceleration for fully adjustable low to high speed operation. Electro-dynamic braking provides fast rotor deceleration without strain on moving parts and an automatic time-relay permits the rotor to coast to a smooth stop without disturbance of sediment.

Refrigeration design permits operation of the rotor with temperatures as low as −10 C during extended high speed runs or at −20 C during shorter runs or at lesser speeds. When operat-

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				Bulletin Numbers
mastics	60-25/26	C. I. MASTICS	Asphalt vapor-barrier weathercoats	M-1-A/B
	* 60-30N/60N	FIRE-RESISTIVE MASTICS	Non-asphaltic flexible weathercoat with non-flammable solvent	M-1-A/B
adhesives	81-13	ADHESIVE A-90	Brush-grade adhesive for low-density insulations	A-1-A/C
	81-33	FIRE-RESISTIVE ADHESIVE	Hard-setting for rigid high-density insulations	A-1-A
	81-42W	LAGFAS	Economical adhesive for lap-sealing and sizing canvas	A-1-B
	81-60	FIRE-RESISTIVE ADHESIVE	For blanket or high-density duct insulation	A-1-A/C
	81-63/66	INSULATION ADHESIVES	Low-cost brush and trowel-grade adhesives	A-1-A
	81-71/81	DUCT-FAS	Quick-tack with long-open time adhesives for duct insulations	A-1-A/C
	81-91	DUCT-FAS WHITE	For lap-sealing white vapor-barrier jackets on pipe covering	A-1-A/C
	82-18	DUCT-FAS QUICK-TACK	Fast-setting clear rubber cement for insulation facings and jackets	A-1-A/C
	* 81-99	SAFETEE DUCT-FAS	Non-flammable, fire-resistive duct-insulation adhesive	A-1-A/C
coatings	30-42	VINYL VAPOR BARRIER	White vapor-barrier finish coat	C-1-A
	* 30-36	SEALFAS	Light-colored fire-resistive, abrasion-resistant sealer	C-1-A
flashings	30-14	ASPHALT SEAM SEALER	Waterproof, good chemical resistance	F-1-A
	* 60-30N	FIRE-RESISTIVE MASTIC	Non-asphaltic, non-flammable, non-bleeding, elastic	F-1-A

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The Bulletins listed on the right-hand column above are designed to help you solve specific insulation-protection problems.

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Bulletin _____ _____ _____ _____ _____ _____ _____

ing under a vacuum, material temperatures can be maintained within one C for temperatures falling as low as −10 C.

Lourdes Instrument Corporation, 53rd St. and First Ave., Brooklyn 32, N. Y.

FIVE STANDARD WIDTHS

Ranging from 12 to 29 in., Panelcoil is now offered in five standard widths, all of which can be made to exact length requirements up to 143 in. New 29-in. width is seven in. wider than the previous 22-in. industry max. This extra width makes possible reducing the number of units required for a given heating or cooling job.

Dean Products, Inc., 1048 Dean St., Brooklyn 38, N. Y.

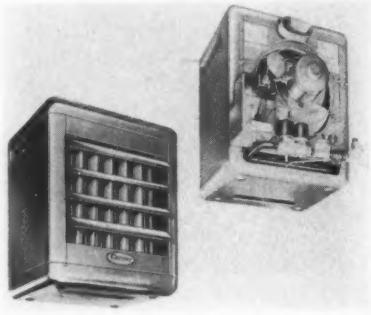
OIL-FIRED LINE

Features of the new Winkler Oil-Fired Furnace line include corrugated design to permit expansion and contraction without noise, circulation of return air completely around the heat exchanger to assure max heat transfer, foil-faced cellular asbestos insulated casing, dust-proof elevated pan-type bottom, large standard filters, completely automatic controls and oversize low speed blower. Burner is capacity matched for all models. Furnaces are available in basement, counterflow and vertical models, with capacities to 170,000 Btu/hr output. All are easily convertible for summer cooling.

Stewart-Warner Corporation, Heating and Air Conditioning Div, Lebanon, Ind.

UNIT HEATER

Lower operating cost and elimination of sudden blasts of hot air are cited for this gas-fired unit heater, a fully



automatic, two-speed, propeller type. Operation begins at a low heat output and fan speed under the control of a two-stage thermostat, which maintains this initial low speed unless more capacity is needed. The thermostat then automatically shifts to high heat output and fan speed. An output of 30,000 Btu in the low stage and 50,000 Btu in the high stage are offered currently.

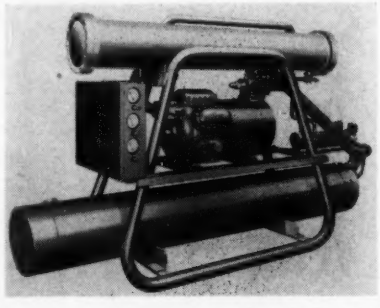
Carrier Corporation, Syracuse 1, N. Y.

RECIPROCATING CHILLER

Redesigned, and with a hermetic reciprocating compressor, this cold generator is available in 10 sizes, from 10 to 100 ton. Operating at 1750 rpm, the compressor is designed for Refrigerants 12 and 22 and has a volumetric efficiency of 85% at 40 F suction and 105 F condensing temperatures.

Protecting valves and pistons from damage due to slugs of liquid refrigerant or oil are a large suction separation chamber and safety head, while an enclosed force-feed oil system with filters, magnetic plugs and carefully located and proportioned oil passages, insures a supply of clean oil to all bearings.

Another new component of the chiller is an evaporator of the direct expansion type, with refrigerant in



the tubes and water in the shell. Urethane foam insulation covered with a 20-gage steel jacket prevents heat pickup and condensation on the shell.

Applications of the reciprocating chiller are with individual room units, zoned systems, central systems or with dehumidifiers and sprayed coils. It can also be used as a water-to-water heat pump.

Trane Company, La Crosse, Wisc.

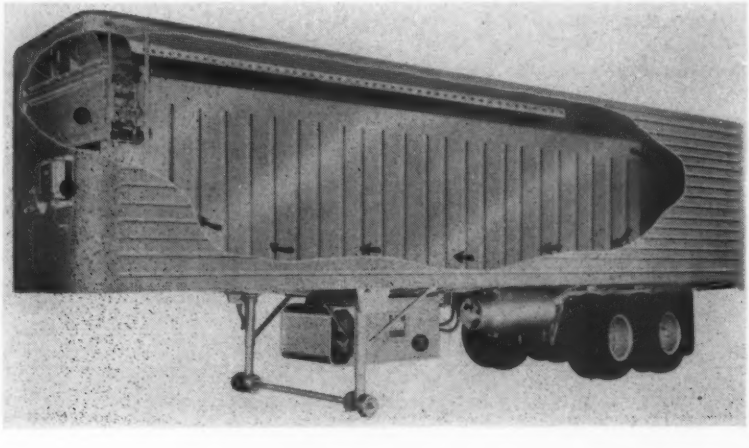
TRAILER REFRIGERATION SYSTEMS

Systems in the 700 Series line include a basic installation for regular sub-zero frozen and fresh food service, as well as specifically modified systems for desert service, extreme low temperatures, fresh vegetable and meat service and a "universal" model designed to give peak performance at both extremes of the temperature scale.

Cutaway of a trailer shows major components of the system. Occupying only one ft in width of trailer space, the evaporator (1) draws return air under bulkhead at floor level, distributing chilled air throughout the load from an overhead duct. An under-floor gasoline or LP fuel-driven engine-condenser unit (2) is accessible from all sides. The condenser engine idles continuously, when not under load, to give instant heating or cooling as required. Both condenser and evaporator are floor mounted, reducing stress on trailer superstructure. An operator's panel (3) is visible from the cab.

Service for both evaporator and condenser is speeded by provision of flexible refrigerant hose with self-sealing couplings and electrical cable with plug and receptacle couplings. The entire condenser assembly may be lowered for shop service or hoisted into position with conventional automotive shop equipment.

Sumner Industries, Inc., Tru Kooler Div, Oelwein, Iowa.



ALARM SYSTEM

Designated Temp-Guard, this unit sounds a warning buzzer and raises a mechanical flag when temperature in a refrigerated case or chill room rises above set levels. A time delay feature prevents the alarm from operating during normal defrosting periods or during short duration temperature rises. Consisting of a heat sensing unit, control thermostat and alarm unit, the system is installed easily and requires little maintenance.

Alarm unit can be mounted at the case being protected or, in the case of multiple installations, on a central

WOLVERINE

TEMPERS TUBING TO

CUSTOMER REQUIREMENTS

Do your requirements call for commercial copper or copper alloy tubing in a special temper? One perhaps, which will permit tighter bends, withstand expansion or contribute to better workability?

If you do, Wolverine Tube, Division of Calumet & Hecla, Inc., can meet your needs either from its normal range of tempers or, on your request, will temper your tubing to meet your specifications.

Wolverine's normal range of tempers for commercial tubing includes: ***soft annealed*** (.040 mm. grain size min.) ***light annealed*** (.040 mm. grain size max.) ***light drawn*** (36,000-47,000 psi tensile Rockwell 30T, 30-60) ***hard drawn*** (45,000 psi min. tensile) (Rockwell 30T-55 min.), Drawn General Purpose (36,000 psi min. tensile) Rockwell 30T-30 min. Frequent inspections throughout the production process assure that tempers will meet customer requirements.

Before placing your next commercial tubing order talk to your Wolverine sales representative. He can show you the many ways in which Wolverine Tube can help you obtain maximum value for your tubing dollar. Write, too, for a copy of the Commercial Tube Catalog.

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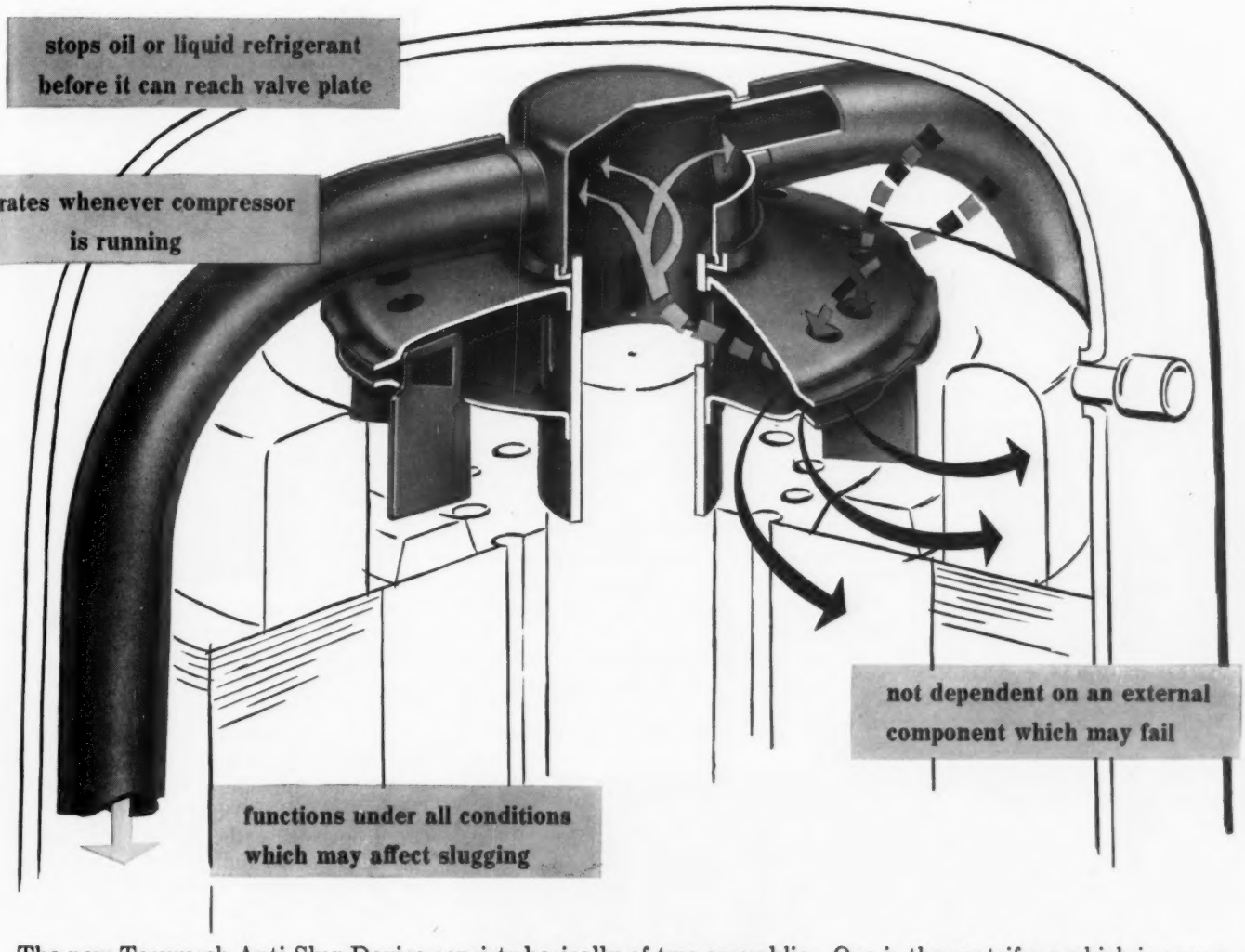
NOW... the engineering breakthrough long-needed by the industry..

. . . A major step forward in the prevention of slugging. Where previously, after prolonged shutdown, residential air conditioning compressors have had a tendency to slug when started, Tecumseh now offers the best solution available to overcome this problem. With a normal charge and minimum runs, this foolproof Anti-Slug Device prevents oil or liquid refrigerant from reaching the compressor valves. Available on Tecumseh residential air conditioning and heat pump models, this feature under proper conditions eliminates compressor damage (broken valves, blown gaskets, or broken rods) caused by slugging. This patented new mechanical device effectively separates the refrigerant gas from the oil and liquid refrigerant and allows only low pressure gas to reach the cylinder. Built integrally within the compressor, it is not affected by any external factors and is **always** operating when the compressor is running.

A new internal thermostat developed at Tecumseh follows motor temperature with extreme accuracy and removes the compressor from the line at a safe temperature level. The thermostat like the Anti-Slug Device—is unaffected by outside variables and therefore protects the motor to extremely close limits. This is particularly critical in heat pump applications which operate over a wide range of ambients. These features are positive proof that Tecumseh alone offers the industry compressors specifically designed for the residential market.

TECUMSEH'S exclusive *NEW* ANTI-SLUGGING *FEATURE*


stops oil or liquid refrigerant before it can reach valve plate
erates whenever compressor is running
not dependent on an external component which may fail
functions under all conditions which may affect slugging

The new Tecumseh Anti-Slug Device consists basically of two assemblies. One is the centrifuge which is press-fit on the crankshaft and therefore rotates at the speed of the compressor. The suction of the piston pulls in the refrigerant and oil mixture in the dome through the holes on top. The paddles help in breaking up this mixture and the liquid refrigerant and oil are expelled through the slots by centrifugal force. The gas, being lighter, is drawn through the slots in the hub. The second assembly is merely a collection pan which has two tubes leading to the cylinder heads and the valves. This assembly is stationary and fits over the hub of the centrifuge, directing the gas to the cylinders. With a normal charge, little if any oil or liquid refrigerant reaches the valves, thus greatly minimizing the possibility of slugging. This exclusive feature is one more example of industry progress made possible by Tecumseh engineering advancements.

forty million compressors in the field

TECUMSEH PRODUCTS COMPANY

MARION, OHIO
TECUMSEH, MICHIGAN

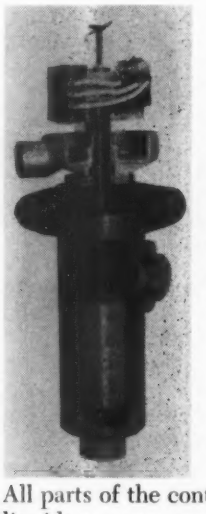
FOREIGN OPERATIONS DIVISION. Tecumseh, Michigan

CANADA: Tecumseh Products of Canada, Limited, 1667 Dundas St., London, Ont.

control panel. Low voltage operation, two flashlight batteries or a step-down transformer from house current provide simplicity in electrical wiring and hook-up of the device.
Richmond Refrigeration Service, Inc., 765 Post Ave., Staten Island 10, N. Y.

LIQUID LEVEL CONTROLS

Advantages cited for Models NM-1 and NM-2 are: immunity to galvanic or electrolytic attack, corrosion resistance, immunity to oxidizing agents, smooth surface which discourages scale, and absence of odor and taste. Construction of non-flammable and non-sparking materials assures safety in handling inflammable and explosive liquids as well as in volatile fume areas. All parts of the control in contact with liquids or vapors are of polyvinyl chloride.



For use in controlling any liquid of specific gravity of 0.70 or above, these controls have chamber and float construction for service at 100 psi at 70 F or 50 psi at 140 F. Model NM-1 is an external float cage unit with a sealed body and float totally enclosed; Model NM-2 is a flanged style chamber unit, with head flange secured to the chamber by means of a Victaulic closure with gasket. They are provided, on standard units, with one-in. pipe socket connections. Shown is a cut-away of Model NM-2.
Magnetrol, Inc., 2110 S. Marshall Blvd., Chicago 23, Ill.

INSULATION CEMENT

Without shrinkage, this cement can be packed by hand, troweled, injected, palmed, sprayed or poured to any thickness. It can withstand freezing, is non-rusting and non-corrosive to metal.

This hard finish, quick-set, one-coat insulation cement can be applied to such materials as glass fiber board and blanket, rock cork board, foam glass block and rock wool blanket without use of hex wire. Pre-molded jackets for pipe fittings of any size can be made in two pieces and are applied easily.
Thermold Products Company, Grandview, Mo.

STAINLESS STEEL ENCASED

For reach-in and sliding door cabinet applications where stainless steel is required, this manufacturer now offers a Model C unit cooler with a stainless steel casing and with all other parts specially treated for protection from corrosive atmospheres. This new unit is available in three sizes (1300, 1700 and 2300 Btu/hr at 10 F).
Bohn Aluminum & Brass Corporation, Danville Div, Danville, Ill.

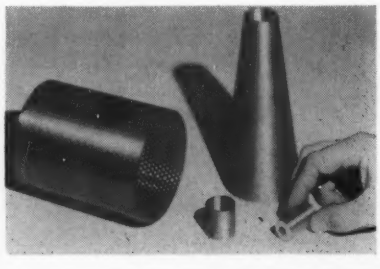
FILTER DESIGN

Clamp closure permits removal of the body tube, cleaning and reinstallation of this filter in a short time, while pipe lines are kept uncontaminated. Several pipe sizes are available.

Filter contains a porous metal element which can be used with or without a filter aid. Elements can be supplied as cylinders, bayonets, stars or in special types such as corrugated sintered woven wire mesh. Materials available include stainless steel, monel, nickel, inconel and others on special order. Filter can be designed to withstand up to 10,000 psi; 125 or 300 psig is standard.
Micro Metallic Div, Pall Corporation, 30 Sea Cliff Ave., Glen Cove, N. Y.

POROUS METAL

Produced as cylinders, cones and various geometrical figures of revolution, Porostrand, an addition to this company's line of wound wire porous metals, offers designers a variety of engineering features, including accurate pore size control with ratings of 10 and 20 micron nominal and 25



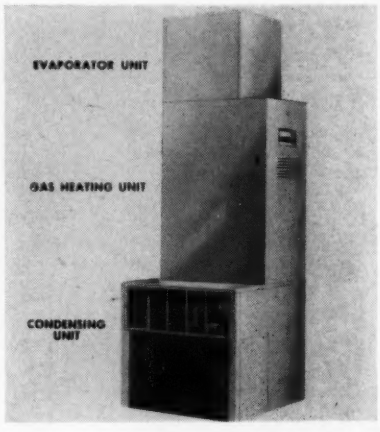
and 50 micron absolute. Present equipment can produce the metal with dimensions ranging up to 120 in. long and 48 in. diam. Cylinders of this material are cited as having high ratings in axial compression strength, burst strength and modulus of elasticity.
Bendix Filter Div, Bendix Aviation Corporation, 434 W. 12 Mile Rd., Madison Heights, Mich.

REMOTE CONTROL UNIT

Available in one-hp, 115 and 230-volt sizes, this new remote control room air conditioner enables the user to adjust cooling or heating temperatures, air direction, volume and exhaust without approaching the unit. Placement of the thermostat inside the remote control panel rather than in the air conditioner is cited as providing truer room temperature control.
Whirlpool Corporation, St. Joseph, Mich.

ALL-SEASON PACKAGE

For apartments and small commercial applications, this equipment, including gas furnace, cooling coil and air-cooled condensing units, fits within a 36 x 36-in. closet, providing complete, ducted all-season conditioning. Installed, the air handling face of the condensing unit extends through an



outside wall and is flush with the outer wall surface. The part of the condensing unit that remains in the closet becomes a base for the furnace. Cooling coil is mounted on top of the furnace, with trunk duct taken off the side of the cooling coil cabinet.

This unit provides nominal two-ton cooling and 51,000 Btu input heating. For convenience the furnace can be set facing either right or left. Design of the condensing unit lets it handle intake and exhaust air on the same side. Pre-charged refrigerant lines with self-sealing "quick couplers" are standard equipment. Furnace has a continuous welded heat exchanger, aluminized steel burners, built-in draft diverter, 24-volt control system, throwaway air filter and a quiet direct-drive blower.
Lennox Industries, Inc., Marshalltown, Iowa.

RECESSED MODEL

By recessing the Safti Wall-Vent heater, this company has obtained a unit which occupies less space without loss of operating efficiency. Recessed 3¼ in. into the wall, the unit is vented directly through the outside wall, leaving only 5¾ in. exposed, as compared with its former extension of nine in. Although designed primarily to heat rooms in resi-

THESE ARE EXTRAORDINARY FLUXES

The correct selection of flux can offer unexpected help in speeding and simplifying production, minimizing rejects and lowering costs in low temperature silver brazing operations. The advantages to be gained by "selective fluxing" are *sufficiently important to warrant careful, thorough study!*

Silvaloy offers the most advanced flux developments in this specialized field. Here, is *a complete line of fluxes* . . . each providing outstanding performance, enabling you to select the correct flux for every possible low temperature brazing operation. The extra efficiency of Silvaloy "Selective Fluxing" is being proved daily on the brazing production lines of the country's leading manufacturers.

Call the Silvaloy distributor in your area for consultation and detailed information or, send for our booklet "A Complete Guide to Selective Fluxing for Low Temperature Silver Brazing."

Silvaloy fluxes are packaged in 65-lb. and 30-lb. drums, 5-lb. wide mouth jars (5 to a carton), 1-lb. and ½-lb. jars. The wide opening of the 5-lb. package makes it a most practical, time saving dispenser that also enables the operator to make use of every bit of flux in the jar.

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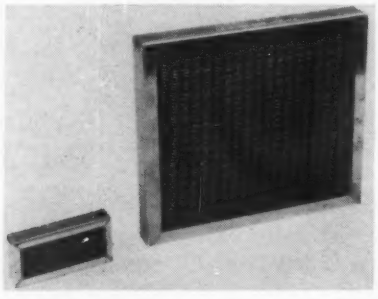
dential or commercial dwellings, the heater can be used also to supplement inadequate heating systems.

Of sealed unit construction with heating element lined with glass, it is available in two sizes, of 28,000 and 33,000 Btu input, respectively.

Pioneer Manufacturing Company, 3131 San Fernando Rd., Los Angeles 65, Calif.

AIR FILTERS

Specially designed to protect miniaturized, ventilated electronic equipment, Airsan Type V-10 filters are

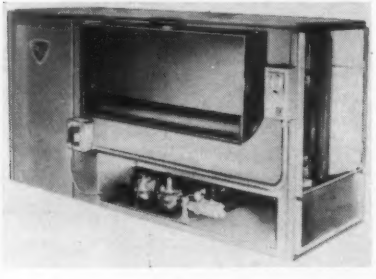


made in an rectangular size and in thicknesses varying from ½ to four in. A permanent filter requiring no replacement, it is available in aluminum, steel, bronze and stainless steel. Offering low initial resistance, its high rated efficiency protects against dust and entrained mist such as water and oil. Internal media retains a constant density that cannot change or shift, and the unit is not affected by climatic or temperature changes.

Air Filter Corporation, 4506 W. Woolworth Ave., Milwaukee 18, Wisc.

HORIZONTAL UNIT

Compact and completely assembled, this horizontal gas-fired unit is especially designed to fit in small places. In homes, it may be installed in the



attic, under floors, in attached garage or suspended from joists.

Four different models are available: 60,000, 80,000, 100,000 and 120,000 Btu/hr.

Bar-Brook Manufacturing Company, Inc., 6135 Linwood Avenue, Shreveport, La.

CHANGEOVER CONTROL

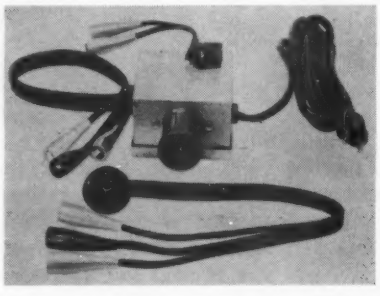
Filling the need for an automatic changeover device for use with combination heating and cooling thermostats, Type 426X Control senses coil water temperature and automatically selects the correct thermostat function. It is recommended for convectors, fan coils and blast coil units where an accurate surface-mounted temperature element is required.

Surface mounting plate of the instrument is a liquid-filled sensing element providing fast response to change in liquid temperature. Single-pole, double-throw silver contacts are enclosed in a tamper-proof, dust-tight enclosure. Range of the control is 60 to 90 F, with fixed differential of approximately 10 F. Electrical rating is 10 amp, full load at 120 volt ac.

Penn Controls, Inc., Goshen, Ind.

SHOCKPROOF TEST CORDS

In addition to acting as general continuity checkers, these cords will diagnose open, start and run windings, defective capacitors and relays, and permit the serviceman to start the compressor independent of the capacitor and relay on the system. Two spe-



cial features are a switch which eliminates the possibility of electrical shocks and female socket extension which permits fast hookup to compressor terminals.

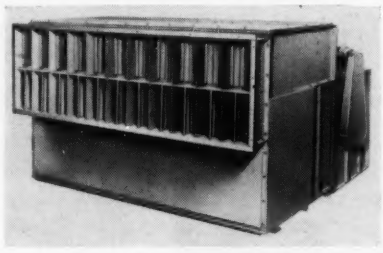
Test Cord 12476 (110 volt) was designed for domestic refrigerator testing, 12263 (220 volt) for window air conditioners.

Robinair Manufacturing Corporation, Montpelier, Ohio.

CENTRAL STATION UNITS

Reduced over-all unit dimensions and a greater number of arrangements and capacities are featured in this new line of central station air handling units. Fourteen sizes, with three to 63 sq ft of coil area, are available in capacities from 1750 to 47,250 cfm. Variety of unit arrangements, including horizontal and vertical draw-through and blow-through Multi-Zone or double duct units, allow selection for specific installations.

Sectional design of the unit permits a selection of components to meet most air conditioning requirements. Selection of the basic unit only, consisting of a fan casing, coil casing and drain pan, provides ventilation, while four types of steam or hot water coils are available when the unit is selected for heating and ventilating and four types of cooling coils (water or re-



frigerant) can be specified when cooling is needed. Dehumidification takes place in the cooling cycle.

As many as 14 zones may be supplied with independent air conditions, and units may be specified in low or medium pressure ranges. Both Multi-Zone and double duct discharge arrangements are possible in blow-through models.

Trane Company, La Crosse, Wisc.

CONTACTORS, STARTERS

Fifty-amp contactors and starters have been added to this line of definite purpose ac motor controls for heating, refrigeration and air conditioning industries. Simplified to incorporate only those elements essential to reliable operation, units are compact in design and suited for use with hermetic type refrigeration and air conditioning compressor units, heat pumps and resistance type electric heaters.

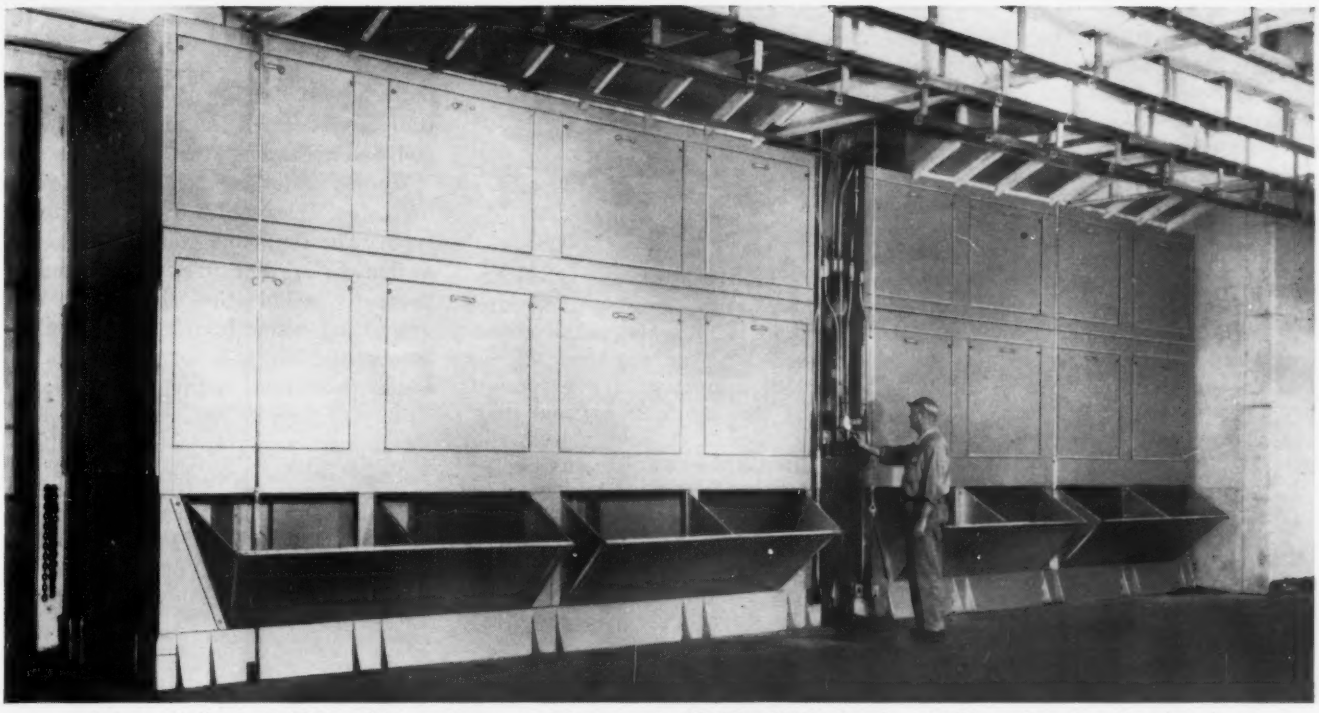
Chief features of the line are quiet magnet structure, low power requirements for commerical or residential systems and a fast thermal overload relay.

Cutler-Hammer, Inc., 315 N. 12th St., Milwaukee 1, Wisc.

SPRAY COOLERS

Redesigned, this line of floor-type industrial refrigeration units which utilizes a continuous liquid defrosting spray for lower temperature applications has been extended to include a range of sizes from 5000 to 25,000 cfm with refrigeration capacities from three to 24 ton. Units are designed to use brine or any suitable liquid as the defrosting medium and ammonia, halogenated hydrocarbon or brine as the refrigerant. They are available arranged for fully flooded operation, liquid recirculation or thermal expansion valve operation.

Choice of either prime surface coils or finned coils with a selection of coil depths to meet most application requirements is available. Units are complete with centrifugal fan assembly, defrosting spray pump and motor,



Quinton Holland, Goldring chief engineer at control panel. CONTRACTOR: Jennings Refrigeration, Inc., Los Angeles.

KRACK BUILDS ONE OF

world's largest unit coolers!

SHIPS 6 WEEKS AFTER ORDER!

Custom-made unit has 110,000 CFM CAPACITY!

When the Goldring Packing Co., fast growing Los Angeles meat processing concern, built a new lamb chilling room they were faced with a refrigeration problem—to secure equipment with enough cooling capacity to hold a 50 x 120 ft. room at a constant 34°F. Ceiling mounted units were out, because of lack of clearance between the conveyor system and ceiling.

A large custom floor unit was the answer and through Pacific Metals Co., western KRACK distributors, the order was placed with Refrigeration Appliances. The completed unit measures 37′ x 12′ x 5′ and was shipped just six weeks after the order was received. The unit is built in two sections, each delivering 55,000 cfm. Automatic defrost is alternated every 24 hours.

Whatever your refrigeration problems are, you can depend on KRACK —for units that deliver SAFETY-MARGIN RATING—for QUICK DELIVERY on standard and custom units.

Unit required two trucks for shipping. Here one-half of unit leaves Refrigeration Appliances plant at Chicago.

Opening in wall of new addition at Goldring Packing Co., Los Angeles permits entry of each half of the huge Krack refrigeration units.

KRACK ENGINEERED REFRIGERATION APPLIANCES, INC.

Manufacturers of Freon or Ammonia, Recirculated, Flooded or Direct Expansion Heat Transfer Equipment

MAIL COUPON FOR INSTALLATION STORY & "BL" BULLETIN

REFRIGERATION APPLIANCES, INC.
917 W. Lake St., Chicago 7, Ill.

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Firm_____

Street_____

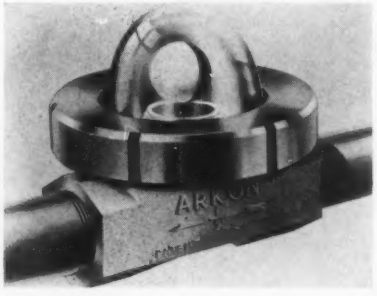
City_____ Zone____ State_____

0299

spray header and nozzles, sliding type removable eliminator section and full length access doors.
Imeco Inc., 3033 W. Belmont Ave., Chicago 18, Ill.

LOW FLOW INDICATOR

For flows down to 0.075 gpm (water) and 0.5 cfm (air or gas), this indicator shows by means of a moving ball in a glass dome whether flow is taking place. Flow causes the ball to bounce in the dome; if flow stops, the ball



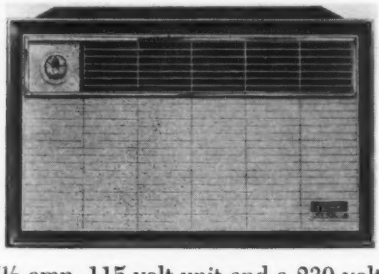
drops out of sight. Indicator is made in ½-in. pipe size for pressures up to 100 psi, with die-cast bronze body and Nylon or Teflon ball.

Applications include use in air, steam, water and oil purge lines to instruments and mechanical seals; cooling water to compressors and condensers; lubricating oil to bearings, and others.
McIntosh Equipment Corporation, 15 Park Row, New York 38, N. Y.

ROOM AIR CONDITIONERS

Three complete lines of room air conditioners for 1960 are being offered by this manufacturer. Changes in the lines include a new compressor featuring dual pistons with automotive type piston rings, dual suspension, multi-direction air grilles and a new type of filter.

Adventurer, the small line of conditioners (shown), is available in a



7½ amp, 115 volt-unit and a 230 volt-unit, as well as in reverse cycle models to provide heat.

Of medium-size, the Discoverer also will be available in 7½ amp, 115-volt models; 12 amp, 115 volt models; 230 and 208-volt units, and in reverse cycle heat pump series.

A multi-room conditioner, the Conqueror, will be made in 115, 208 and 230-volt models in a wide range of amperages. Heat pump Discoverer and Conqueror models will have additional electric heating available in the larger units.
York Div, Borg-Warner Corporation, York, Pa.

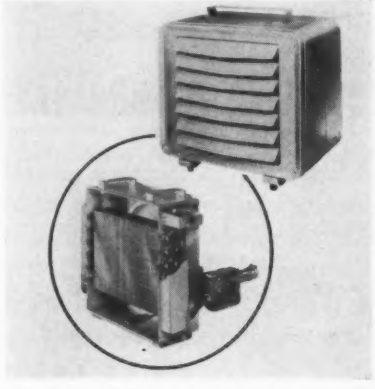
ADJUSTABLE SPEED DRIVES

Of integral-unit construction, rated from ¼ to 100 hp, Magnaflow adjustable speed drives are designed for use with conveyors, fans, pumps, winders and metal slitting and forming machines. Larger drives with separate motor mounted on a bedplate are offered up to 700 hp liquid cooled. In addition, simple control modifications to provide a variety of speed operating functions are also available.

Drive can be set before or during operation to deliver any desired speed within its range, maintaining that speed regardless of any change in load. Each drive operates on ac power, without any brushes, commutators or slip rings to maintain.
Westinghouse Electric Corporation, P. O. Box 2099, Pittsburgh 30, Pa.

UNIT HEATERS

Capacities of Unit Heetaires (Series 600) range from two to ten kw with



208, 240, 480 and 575 volt in single and three-phase types, with either built-in or remote thermostat controls. Units are designed to be suspended either from the ceiling or wall or used as portables.

Elements consist of helically-coiled nickel-chromium alloy resistance wire imbedded in magnesium-oxide, enclosed in stainless steel sheaths to which stainless steel fins are braised.
Markel Electric Products, Inc., Buffalo, N. Y.

COOLING COILS

Greater capacity per unit volume than previous coils is cited for this line, which features a newly developed fin configuration increasing heat transfer efficiency, a new casing design which reduces overall coil dimensions, eliminates air bypass and minimizes moisture carry-over on the dehumidifying coil, and streamlined cast iron headers.

Chilled water cooling coils include drainable, cleanable and standard types. The drainable coil is designed so that each row of tubes drains simultaneously, eliminating the need for evacuating water from the coil with compressed air and for winter anti-freeze protection. Refrigerant cooling coils, designed for applications where direct expansion refrigerants such as Refrigerants 12 and 22 are used, utilize one-piece, multi-circuit refrigerant distributors which insure uniform distribution to all coil circuits. One refrigerant distributor to a maximum of 12 circuits is used.
Trane Company, La Crosse, Wisc.

PIPE JOINT SEALER

Thred-Tape Pipe Joint Sealer is now offered in four widths—¼, ½, ¾ and one in.—permitting selection of the size best suited to the joint to be sealed. Made in chemically-inert Teflon, this sealer is cited as being effective in handling acids, caustics, corrosives, biologicals, toxics and gases. It can withstand temperatures from −250 to 500 F and may be used on all types of piping.
Crane Packing Company, 6400 Oakton St., Morton Grove, Ill.

HEATER ASSEMBLIES

Gas-fired duct heater assemblies for complete or supplemental heating of industrial and commercial buildings have been added to the line of this manufacturer. These assemblies consist of two, four or six gas-fired duct heaters, a plenum chamber, motor-driven fan and a fixed or revolving discharge.

Self-contained, the units need little vertical space and require no connec-

tion to duct work. Assemblies are available in five sizes with output capacities ranging from 368,000 to 1,104,000 Btu/hr. Four revolving and four fixed discharge designs suit installations with mounting heights up to 50 ft and coverage of floor areas up to 132 x 132 ft by a single unit.
L. J. Wing Manufacturing Company, Linden, N. J.

Engineered to

RETAIN YOUR PRODUCT LEADERSHIP

Alco Designed
CONTOUR POWER ASSEMBLY
Increases power element life as much as 10 times over other designs by reducing extreme flexing of the diaphragm. Standard construction on all ALCO "T" Series and "HTL" Series.

Alco Designed
RAPID RESPONSE REMOTE BULB AND WELL

- Reduces danger of floodback
- Extra-quick closing response
- More efficient control over wider range of operating conditions
- Economical to install in package units
- Available on all Alco Gas Charged Valves when specified

Alco Designed...
for easy capacity changes or cleaning without breaking connections or removing valve from line.
Simply . . . loosen **2** bolts . . . lift out cage . . . clean and replace.

ALCO T-SERIES
*THERMO EXPANSION VALVES

• Refrigerants: FREON-12 from ½ ton to 50 tons, FREON-22 from 1 ton to 80 tons, CARRENE-7 from ¾ ton to 60 tons, PROPANE from 1 ton to 88 tons • 2 BODY DESIGNS meet every requirement—STRAIGHT THRU CONNECTIONS or RIGHT ANGLE CONNECTIONS • WIDE VARIETY OF CONNECTIONS (Outlets to match distributor requirements • EXTERNAL or INTERNAL EQUALIZER • EXTERNAL or INTERNAL SUPERHEAT ADJUSTMENT • TIGHT SEATING . . . STAINLESS STEEL STEM AND SEAT • CORROSION-RESISTANT MATERIALS • MOUNT IN ANY POSITION • NO SPECIAL WRENCHES or GUIDES REQUIRED FOR CLEANING AND SERVICING

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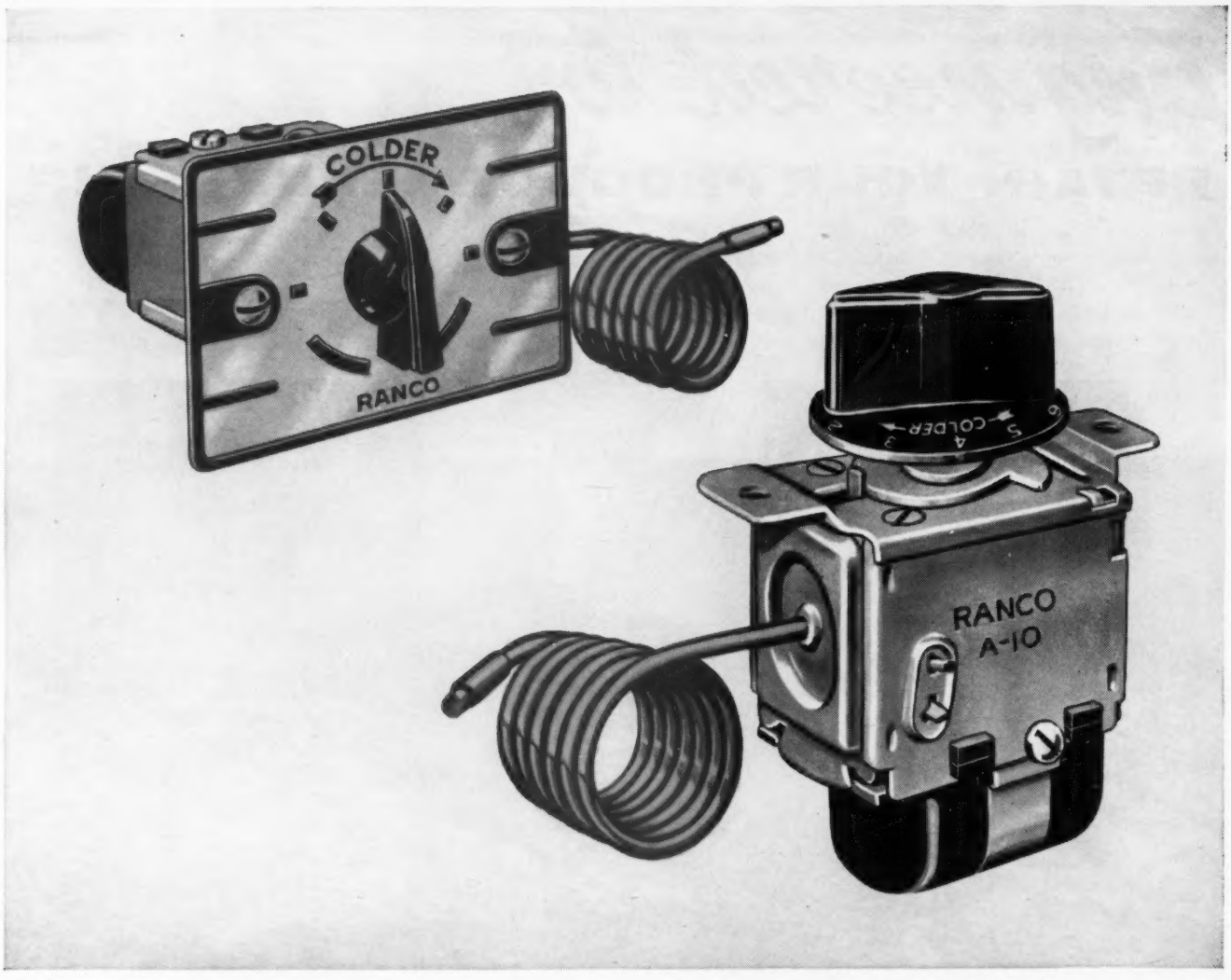
The one complete line of refrigerant controls: Thermostatic Expansion Valves• Refrigerant Distributors Solenoid Valves • Suction Line Regulators • Flooded Evaporator Controls and Reversing Valves



Two types of Ranco "A 10" controls designed for use in room air conditioners. The .094" capillary tubing is coiled as a 1" x 1" air bulb. Other types of "A 10" controls are widely used in domestic and commercial refrigeration.

Ranco precision air conditioner controls require copper capillary tube of consistently high accuracy and quality

The compact "A 10" thermostatic controls of Ranco, Inc., Columbus, Ohio, are precision instruments built for long life in air conditioning and refrigeration service. One of the control's critical elements is the .094" O.D. copper capillary tube operating with the bellows as the power element.

Ranco finds that Anaconda copper capillary tube has the uniformly high quality and dimensional accuracy required for economical high volume production. The French Small Tube Division of The American Brass Company are specialists in making tube, one-piece bulb and capillary units, and fabricated tube parts for the refrigeration and air conditioning industry. These specially tailored, scrupulously clean tube products meet strict dimensional specifications, and are free from defects that could cause erratic operation.

Quality Tube and Creative Technical Services. Whether you need capillary tube, restrictor tube, bulb and capillary units or fabricated tube parts—in either copper or aluminum—the French Small Tube Division has specialists to help you find the most economical way to do the job. And it has the experience and facilities to supply the tubing you need. For further information or technical assistance, write: French Small Tube Division, The American Brass Company, Box 1031, Waterbury 20, Conn.

6028

ANACONDA®

CAPILLARY AND RESTRICTOR TUBE

Made by French Small Tube Division of

THE AMERICAN BRASS COMPANY

ANACONDA PRODUCTS FOR THE REFRIGERATION AND AIR-CONDITIONING INDUSTRY

JOURNAL
OFFICIAL PUBLICATION
MAY 1960

How the method of

Rating the cooling load

for refrigerated trailers has been standardized

P. R. ACHENBACH
Fellow ASHRAE

C. W. PHILLIPS
Member ASHRAE

W. F. GODDARD

Up to the present there has been no standard method for measuring the cooling load of refrigerated trailers. One objective of a recent program at the National Bureau of Standards was to develop such a method which would enable a trailer manufacturer to establish and publish a rating for each of his models. Thus, a purchaser, knowing these ratings, and considering also the products being carried, length of the haul, and other factors, would be able to select the size of refrigerating unit best suited to his needs. He could avoid selecting equipment either inadequate in capacity or unnecessarily costly for the job.

Earlier Bureau field tests of a number of 35-ft refrigerated trailers and refrigerating units showed that not every refrigerating unit had sufficient capacity to provide suitable temperatures for transporting frozen food in any of the trailers. Other investigators[1] have shown that air leakage into refrigerated trailer bodies is a significant method of moisture entry.

A standard testing and rating method covering cooling load, weight gain due to frost accumulation, and air leakage has now been formulated and adopted by the Truck-Trailer Manufacturers Association. It is being published by the U. S. Department of Agriculture, which sponsored the program along with the Truck-Trailer Manufacturers Association, the Quartermaster Research and Engineering Command of the Department of the Army, and the National Bureau of Standards.

Recently completed tests at the Bureau established that air leakage through the exterior skins of commercial trailers accounted for a substantial portion of the cooling load of these trailers under operating conditions on the road. Air movement was found to bring considerable moisture into the insulated space, much of which accumulated as frost in the insulation spaces.

OBJECTIVES OF STUDY

Objectives of the program at the Bureau were:

1 – To compare the cooling loads of several trailers as measured in the laboratory with the cooling loads of the same trailers measured during road operation, using a method which provided cooling of the interior of the trailer to typical storage temperatures for frozen food.

2 – To modify the laboratory test method so that it could be used to measure the heat transfer that

Based on studies undertaken at the National Bureau of Standards to develop a laboratory method for determining accurately the cooling load of a refrigerated trailer during road operation, a standard rating method has been formulated and adopted by the Truck-Trailer Manufacturers Association. Reporting upon developments which led to this standard, the authors include a discussion of air leakage and frost deposits in trailer walls, factors which do increase the cooling load.

P. R. Achenbach is Chief and C. W. Phillips and W. F. Goddard are Mechanical Engineers, Air Conditioning, Heating and Refrigeration Section, National Bureau of Standards.

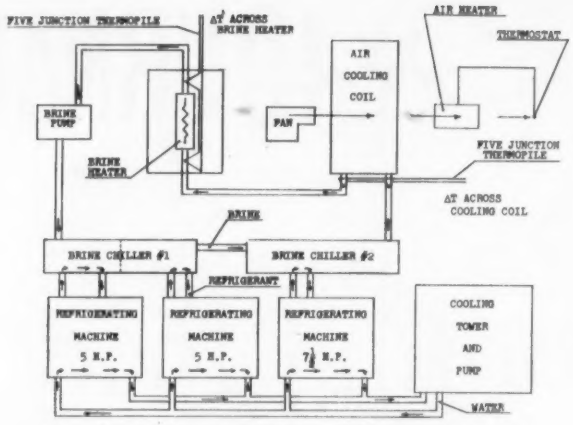


Fig. 1 Schematic diagram of the refrigerating circuits in the heat sink apparatus used for the laboratory tests

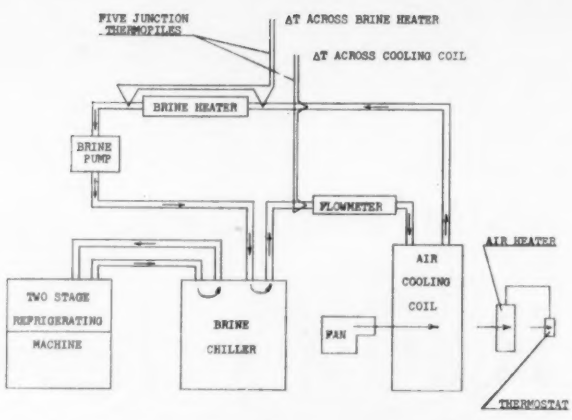


Fig. 2 Schematic diagram of the refrigerating circuits in the heat sink apparatus used for the road tests

would occur on the road under stated conditions of temperature, humidity and air leakage, taking into account effects of wind, air pressure and solar radiation.

3 – To provide information on air-leakage and moisture-transfer processes in refrigerated trailers that might suggest improved insulating and vapor-sealing methods.

4 – To draft a proposed standard testing and rating method for refrigerated trailers with regard to cooling load, weight gain and air leakage.

Seven trailers, four of them commercial and three military, were used in the tests.

The military vehicles were 7½-ton, 21-ft single-axle trailers, manufactured to U. S. Army specifications. They all had aluminum exterior and interior surfaces and various forms of extruded or formed aluminum floors. Glass fiber insulation was used in the walls and roof, and expanded polystyrene in the floors. Empty weights were about 7,300 lb.

Some of the principal physical and construction characteristics of the four commercial trailers are summarized in Table I.

LABORATORY TESTS AND PROCEDURES

The room for laboratory tests was about 60 ft long, 14 ft wide, and 16 ft high, with insulated walls and roof and a concrete floor. A sliding overhead door, 12 ft wide and 14 ft high, was installed to permit movement of semi-trailers into the space.

Controls and equipment were set to maintain the desired test conditions of 0 F temperature in the trailer, and 100 F dry bulb temperature and 50 percent relative humidity in the test room.

A heat-sink apparatus[2] was used to produce the desired low temperature inside the trailer and to measure the rate of heat transfer into the vehicle. It consisted of three electrically-driven two-speed compressors, with water-cooled condensers, a water cooling tower, two brine chillers, a brine pump, a comparison brine heater, a cooling coil inside the trailer, and suitable measuring instruments.

In the heat-sink apparatus, chilled brine was pumped continuously through the closed loop which included the air cooling coil inside the trailer, the comparison brine heater outside the trailer, the brine chiller and the circulating pump. Readings were taken at regular intervals for periods ranging from 50 to 130 hr.

The cooling coil inside the trailer was equipped with an in-

TABLE I
COMMERCIAL TRAILERS IN COOLING LOAD TESTS

Trailer	Length	Material in Exterior Skin	Material in Interior Skin	Wall Insulation Material	Wall Insulation Thickness in.	Floor Insulation Material	Floor Insulation Thickness in.	Roof Insulation Material	Roof Insulation Thickness in.	Empty Weight lb
A	35 ft	Riveted Aluminum	Marine Plywood, Plasticized Plywood and Aluminum Alloy	Glass Fiber, Paper Vapor Barrier and Rigid Expanded Polystyrene	4	Rigid Expanded Polystyrene	4	Glass Fiber and Paper Vapor Barrier	6	13,510
B	33 ft 4 in.	Stainless Steel, Spot-welded	Plywood and Aluminum Alloy	Glass Fiber	6	Rigid Expanded Polystyrene	5	Glass Fiber	6	9,722
C	34 ft 10 in.	Riveted Aluminum and Aluminum Alloy Sheets	Aluminum, Aluminum Alloy, Plywood and Plastic	Glass Fiber Batts	6	Not known	Not known	Glass Fiber Batts	6	13,410
	35 ft	Riveted Aluminum Sheets	Aluminum Alloy, and Treated Plywood	Glass Fiber	6	Rigid Expanded Polystyrene	6	Glass Fiber	6	12,563

tegral blower, and additional oscillating fans were used to improve air distribution. A shielded electric space heater, under thermostatic control, maintained the desired temperature within the trailer by offsetting the slight excess of refrigeration provided.

The comparison brine heater consisted of a vapor-proofed insulated box containing an electric immersion heater inserted in the brine line between the pump and the cooling coil inside the trailer. The electric energy consumed by the heater was measured with a calibrated watthour meter.

Since the brine flow rate in all parts of the circuit was the same, the ratio of temperature rise of the brine in the air cooling coil in the trailer to that in the brine heater was equal to the ratio of heat absorbed in the coil to that absorbed in the heater. (Changes in specific heat of the brine between the coil in the trailer and the comparison heater were small enough to be neglected in these tests. Slight heat leakage through the insulation of the brine heater also was neglected.)

After making corrections for auxiliary heat sources inside the trailer, the above ratios were used to calculate the total cooling loads of the trailers resulting from heat transferred through the trailer body by transmission, air leakage, and frost accumulation.

Refrigerants 12 and 22 served as primary refrigerants in the brine chillers. Methylene chloride was used as the brine or secondary refrigerant because of its favorable viscosity, its stability of density and specific heat in the working temperature range, and because it is not excessively toxic or flammable.

As another part of tests performed in the laboratory, weight gain caused by condensation and freezing of infiltrated moisture was measured by means of three calibrated, heavy-duty, platform-type scales, one under each set of back wheels, and one under the front at the king-pin position.

For the road tests, a tractor was equipped with the refrigerating equipment, an electric generator and the instrumentation required for a modified heat-sink apparatus. In this modification the rate of brine flow was measured with an electronic flowmeter, and the cooling load was calculated from this flow rate, and the temperature change and specific heat of the brine in the cooling coils. This tractor was used to operate each of the four commercial trailers for a distance of about 5,000 miles at a speed of 50 mph, day and night, over the level highway on the Ohio Turnpike in order to determine cooling loads under steady road speeds.

TABLE II

WEIGHT GAIN RATE OF FOUR COMMERCIAL TRAILERS UNDER LABORATORY CONDITIONS (AMBIENT 100F, 50% RH; INTERIOR 0 F)

Trailer	Average Weight Gain Rate lb/hr
1	0.98
2	0.32
3	0.54
4	0.52

TEST RESULTS

Results of laboratory tests on the four commercial trailers are shown in Tables II and III. Table II summarizes the rates of weight gain for the four trailers caused by the accumulation of frost in the insulation spaces and on the cooling coil.

Observed cooling loads of the four commercial trailers tested under laboratory conditions with a cargo space temperature of 0 F and ambient conditions of 100 F dry bulb temperature and 50 percent relative humidity are shown in Table III.

Road and laboratory test results for the four commercial trailers are compared in Table IV.

Increase in cooling load of the trailers during road operation was due primarily to greater air leakage when the vehicles were moving; but some of the increase was caused by (1) solar radiation, (2) heating of the under surface of the vehicle primarily by waste heat from the tractor engine and partly by radiation from the road surface, and (3) a greater heat-transfer coefficient at all exterior surfaces because of the higher air velocity.

AIR LEAKAGE

A number of studies were made to determine the location of leaks in a trailer body, to measure air leakage, to study the pressure pattern around a moving trailer, and to find how to simulate in the laboratory the impact air pressure on the front end of a trailer being towed on a highway.

TABLE III

COOLING LOADS OF FOUR COMMERCIAL TRAILERS UNDER LABORATORY CONDITIONS (AMBIENT 100F, 50% RH; INTERIOR 0 F)

Trailer	Observed Total Cooling Load, Btu/hr	Computed Air Leakage* Rate, Cu ft/hr	Computed Heat Gain Rate Due to Air Leakage, Btu/hr Total Dry Air Moisture			Computed Heat Gain Rate Due to Transmission, Btu/hr
1	9,520	710	2410	1170	1240	7110
2	10,300	230	790	380	410	9510
3	7,500	390	1330	650	680	6170
4	9,500	380	1280	620	660	8220

*Calculated from the weight gain on the assumption that the leakage air left the trailer saturated at a temperature of 0 F.

TABLE IV

AVERAGE OBSERVED COOLING LOADS OF FOUR COMMERCIAL TRAILERS DURING LABORATORY AND ROAD TESTS (TRAILER INTERIOR TEMP. 0 F)

Trailer Specimen	Laboratory Tests* Heat Transfer Rate Btu/hr	Btu/hr(F)	Road Tests Ambient Conditions Temp., F	R.H. %	Heat Transfer Rate Btu/hr	Btu/hr(F)
1	9,520	95.2	67.4	59	7,610	112.9
2	10,300	103.0	53.7	51	6,260	116.6
3	7,500	75.0	72.0	80	6,360	88.3
4	9,500	95.0	71.3	74	7,390	103.6

*Ambient Conditions: Temp. 100F, RH 50%

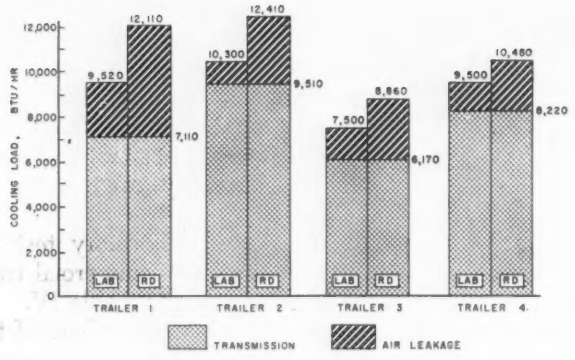


Fig. 3 Comparison of observed laboratory cooling loads and extrapolated road cooling loads at 50 mph for ambient temperature of 100 F, ambient relative humidity of 50%, and cargo space temperature of 0 F

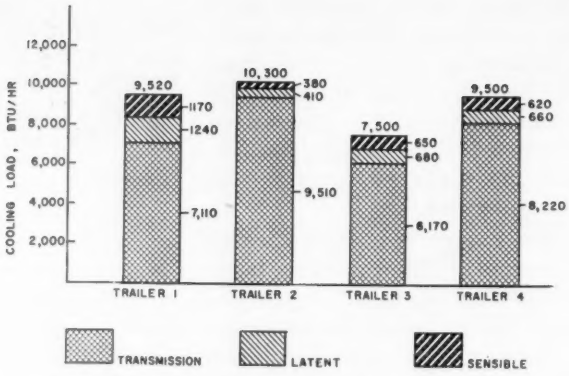


Fig. 4 Total and incremental cooling loads of four commercial trailers under laboratory conditions. Ambient temperature 100 F, ambient relative humidity 50%, cargo space temperature 0 F

Smoke tests were made to locate openings in the external envelope of the vehicle. For this purpose, a smoke bomb that produced large quantities of white smoke was lighted inside a trailer. The door was closed, and the interior pressurized to about 1 in. H_2O by a centrifugal blower whose discharge penetrated a plug at the front of the trailer. Under these conditions, leaks were indicated by wisps or streams of smoke emanating from openings in the skin of the vehicle.

Such smoke tests on several trailers indicated the following results:

Roofs revealed no leaks;

Greatest leakage occurred underneath the trailers where the walls joined the floor structure;

Leakage usually occurred where lights or reflector buttons were attached, or where electrical conduits or other lines penetrated the outside skin;

Some leakage occurred at the door gaskets, but usually in isolated sections;

Some leaks occurred at spot-welded lap joints in the sidewalls and where fluted or corrugated side panels joined other panels at right angles.

A second method of studying air leakage involved use of an infiltration meter. This meter was based on the tracer gas principle, and served to measure air leakage into trailer bodies. However, this apparatus could only be used to measure leakage into the cargo space of the trailer, and was not suitable for measuring air that moved through the insulated cavities without entering the cargo space. These tracer gas studies indicated that the air exchange between the cargo space and the outside was a small fraction of the air exchange through the insulation spaces as computed from the laboratory and road tests.

Another procedure was used to study air-pressure differences on several elements of the trailer body that would cause air leakage through openings in the exterior skin. A pitot tube was mounted in front of the tractor used to operate the trailer on the road. Then 44 small holes, drilled at selected places on the outside and inside skin of the trailer, were connected to a manifold with suitable valves. This enabled the pressure at each hole to be compared with the inside pressure of the trailer, also with the ambient outside pressure as represented by the static line of the pitot tube, as the tractor-trailer combination was operated at various road speeds.

This study revealed that openings in the exterior skin at the front

Fig. 5 Computed total and incremental cooling loads of four commercial trailers at a road speed of 50 mph extrapolated to an ambient temperature and relative humidity of 100 F and 50%, respectively. Cargo space temperature 0 F

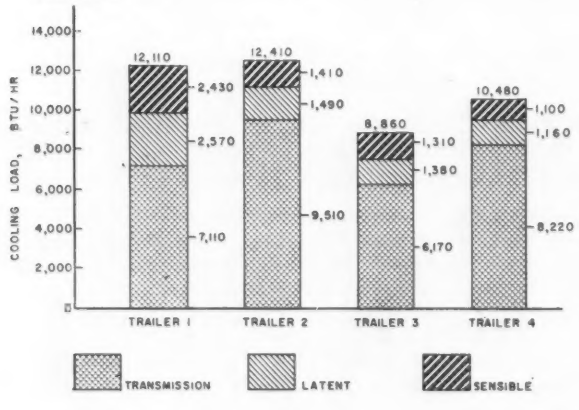
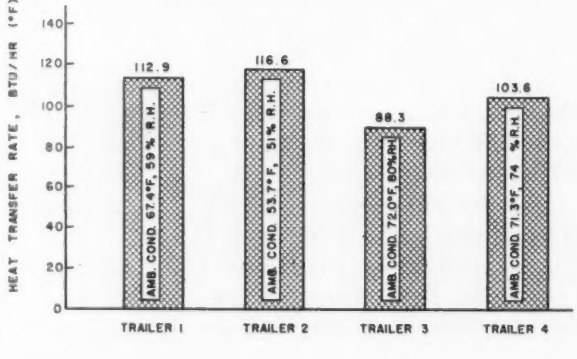


Fig. 6 Average heat transfer rate of four commercial trailers at a road speed of 50 mph under prevailing ambient conditions. Cargo space temperature 0 F



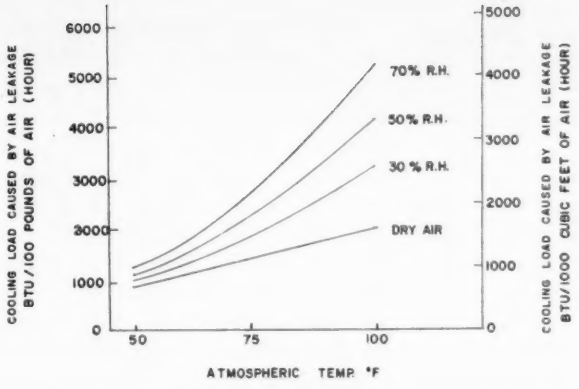

COOLING LOAD CAUSED BY AIR LEAKAGE BTU / 100 POUNDS OF AIR (HOUR)
COOLING LOAD CAUSED BY AIR LEAKAGE BTU/1000 CUBIC FEET OF AIR (HOUR)
70% R.H.
50% R.H.
30 % R.H.
DRY AIR
ATMOSPHERIC TEMP. °F

Fig. 7 Additional cooling load, above transmission cooling load, caused by air leakage at various rates and ambient conditions for a cargo space temperature of 0 F

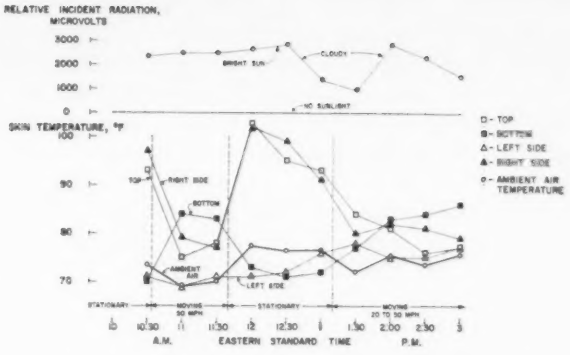


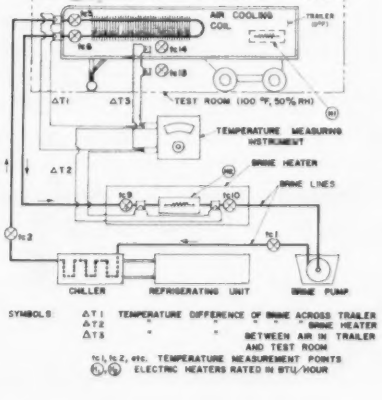
Fig. 8 Effect of solar radiation and road speed of exterior surface temperatures of one of the commercial trailers

end of the trailer would cause more air leakage than those on the other exposures during road operation because the greatest pressure differences existed across the front end. The pressure difference between exterior surface and insulation space was about 1.5 in. H_2O on the front end when the trailer was pulled down the highway at 50 mph on a day without wind. At the same time the pressure difference between exterior surface and insulation space for most of the remainder of the trailer was less than 0.1 in. H_2O and frequently changed direction.

Another laboratory method of measuring air leakage involved exhausting air from the interior of the trailer during the cooling load test. It was concluded that this method was not suitable for evaluating air leakage during road operation, but did constitute a simple procedure for evaluating the overall leakage of a trailer without regard to location of the leaks.

In still another procedure, two trailers were tested in the laboratory with a static pressure applied to the front end to simulate the ram air pressure caused by motion over the road. After some experimentation with a plastics bag over the front end of the trailer, a more permanent plenum was built of plywood and wood framing, with adjustable sponge rubber strips to restrict air leakage at the exterior surface of the trailer body. This last method was considered the best simulation of conditions on the road.

Fig. 9 Schematic diagram illustrating the principle of operation of the heat sink apparatus


AIR COOLING COIL
TRAILER
TEST ROOM (100 °F, 50% RH)
TEMPERATURE MEASURING INSTRUMENT
BRINE HEATER
BRINE LINES
CHILLER
REFRIGERATING UNIT
BRINE PUMP
SYMBOLS
ΔT1 TEMPERATURE DIFFERENCE OF BRINE ACROSS TRAILER
ΔT2 " " " " BRINE HEATER
ΔT3 " " " BETWEEN AIR IN TRAILER AND TEST ROOM
No 1, No 2, etc. TEMPERATURE MEASUREMENT POINTS
ELECTRIC HEATERS RATED IN BTU/HOUR

CONCLUSIONS

Conclusions reached from tests of the four commercial trailers in the laboratory and on the road and from air leakage and pressure distribution studies made on several military and commercial trailers may be summarized in the following way:

Cooling loads of the four empty commercial trailers ranged from 7500 to 10,300 Btu/hr under laboratory test conditions of 100 F ambient temperature, 50 per cent ambient relative humidity, and 0 F cargo-space temperature.

Extrapolation of the observed test results on the road indicated that the cooling loads under the laboratory conditions of temperature and humidity, but at a road speed of 50 mph, would be from 10 to 27 per cent greater than those observed in the laboratory, prineipally as a result of air leakage into and through the body construction under influence of the ram air pressure on the front of the trailer.

A small part of the increase in cooling load on the road was caused by solar radiation and the movement of engine heat under the floor of the trailer. The effect of solar radiation on the cooling load of the trailers was largely nullified by the rapid air motion over the vehicle at a road speed of 50 mph.

The minimum computed air-leakage rates for the four commercial trailers at a road speed of 50 mph were 1475, 860, 790, and 660 cu ft/hr, assuming that the leakage air left the trailer saturated at 0 F. The corresponding computed heat gains due to air leakage at ambient conditions of 100 F and 50 per cent R.H. would be 5000, 2900, 2690, and 2260 Btu/hr, respectively. On this basis, the cooling load due to air leakage ranged from 27 to 70 per cent of the heat transmission component of the total cooling load at a road speed of 50 mph under design test conditions. These percentages indicate the significant reductions possible in heat gain by eliminating air leakage in trailer bodies.

Air leakage and ice accumulation in the trailers were not negligible even under stationary conditions. The air leakage amounted to 710, 230, 390, and 380 cu ft/hr and the ice-accumulation rates averaged 0.98, 0.32, 0.54, and 0.52 lb/hr, respectively, during the laboratory tests. There was probably several times as much air exchange between the insulation space and the outdoors as between the cargo space and outdoors.

The under sides of the trailers were heated as much as 15 F above ambient temperature in some cases

during road operation, principally by waste heat from the tractor engines. This rise could significantly affect the preservation of food on the interior floors of the trailers, if chilled air were not circulated around and under the load.

Without wind effects, ram air pressures up to 1.25 in. H_2O will occur on the front end of a trailer at a road speed of 50 mph on the portions unshielded by the tractor, although the average ram pressure will probably be below this value. The static pressures in the cargo space, in the insulation space, and over most of the exterior surface (excluding the front end and part of the roof) were about equal and ranged from 0.2 to 0.4 in. H_2O below atmospheric pressure for road speeds of 50 mph. The leakage air probably entered the trailer body primarily at the front end of the trailer and left the body over the remainder of the surface, during still weather, leaving most of the moisture in the ambient air deposited as ice in the insulation space. Wind could alter the air movement pattern through a moving trailer and change the pressure pattern on the exterior considerably.

Results indicate that smaller refrigerating units could be used if air leakage is eliminated, or alternately, less insulation might be required if air leakage were significantly reduced. It is also probable that the deterioration of trailer bodies would proceed more slowly if moisture could be kept out of the insulation spaces.

A practical laboratory testing and rating method for refrigerated trailers can be established based on the heat-sink method for evaluation of the cooling load, modified to simulate the air leakage occurring during normal operation of the vehicle on the road. The pressurization of the front end of a trailer by means of an attached plenum is considered to be the most practical and representative simulation of the effects of the ram air pressure for use in a stationary laboratory test.

This method applies a static pressure on the parts of the body that would normally be pressurized on the road and applies approximately the proper weighing to the leaks on the various sides of the body. It does not simulate the effect of cross winds or wind from the rear of the trailer. A frontal pressure of 2 in. H_2O is considered to be an appropriate value for a simulated laboratory test, since it includes an allowance for at least a minimum wind force on the trailer body.

Use of an exhaust blower to measure the air leakage into the cargo space of a trailer under a small negative pressure is an economical and effective method for use on a production line to evaluate overall airtightness of a trailer, to compare different trailers in a laboratory, or to evaluate the change in airtightness of a trailer in regular service.

The smoke test is a simple method for finding the parts of a trailer body that have not been made sufficiently airtight during the manufacturing process or to locate the leaks at any time during the useful life of a trailer.

If trailer construction is improved so that air leakage is a minor factor, some modification of the testing and rating method may be desirable to simulate solar radiation effects and the effect of engine heat discharged beneath or around the trailer.

THE STANDARD

The Standard Testing and Rating Method for Refrigerated Trailers with Respect to Cooling Load, Weight Gain and Air Leakage, has been adopted by the Truck-Trailer Manufacturers Association.

The standard applies to refrigerated trailers of any length used for transporting frozen food or other materials at cargo space temperatures well below 32 F. The standard describes a laboratory method for measuring the cooling load that will satisfactorily represent the cooling load under typical road speeds. The effect of ram air pressure on the front of a moving trailer is simulated by means of a pressurized plenum. The standard does not apply to trailers under stationary conditions or to trailers used primarily for short trips.

Two simultaneous methods are used to determine the cooling load. The first of these – the comparison method – uses the comparison between the temperature rise of the brine in the trailer and the temperature rise in the external brine heater. The second method uses the temperature rise of the brine in the trailer and the mass flow of the brine, as measured by the flowmeter, to determine the cooling load. The results of the two methods must agree within 5 per cent for a given test to be acceptable for rating purposes. The rated cooling load is the average of values obtained by the two methods, expressed to the nearest even 500 Btu/hr.

The rated weight gain is the average weight-gain rate in pounds per hour, for the final 24 hr of the test. It is expressed to the nearest 0.1 lb/hr.

For the air-leakage test, air is forced into the trailer, and the amount of air required to maintain a positive pressure of 0.1 in. H_2O in the trailer is measured. The rated air leakage is expressed to the nearest 0.5 cfm.

REFERENCES

1. Eby and Collister, "Insulation in Refrigerated Transport Body Design," Refrigerating Engineering 63 (7) July 1955.
2. P. R. Achenbach and C. W. Phillips, "Heat Sink Method for Measuring the Cooling Loads of Refrigerated Structures," Proceedings Xth International Congress of Refrigeration, 1959.

ASHRAE NATIONAL MEETINGS AHEAD

1960	1961	1962	1963
June 13-15 Annual Vancouver, B.C.	Feb. 13-16 Semiannual Chicago, Ill.	Jan. 28-Feb. 1 Semiannual St. Louis, Mo.	Feb. 11-14 Semiannual New York, N. Y.
	* June 26-28 Annual Denver, Colo.	June 18-20 Annual Miami, Fla.	

Brave New World of Air Conditioning Explored at

BRI Spring Conferences

Expressions of advanced thinking in almost as many aspects of air cleaning and purification were offered by six speakers at the Spring Conferences of the Building Research Institute in New York April 5-7.

Under the Chairmanship of John E. Haines, Presidential Member of ASHRAE, an all-day session of considerable vigor pointed the way to what is rapidly becoming a more clearly defined future for environmental air.

What Is Pure Air?

A. J. HESS
Presidential Member
ASHRAE

Deterioration in the quality of the atmosphere that we breathe is becoming of major concern to engineers and health authorities today, and the trend is still downward. The pollutant effluents resulting from combustion, other industrial processes, and rubbish disposal is converting our atmosphere into a stinking, poisonous and irritant mess. Even nature contributes to the condition of photosynthesizing the hydrocarbons in the effluents into the irritant peroxides that cause stinging of wet human body surfaces on contact. Nature also produces large volumes of gaseous hydrocarbons from vegetation growing on the earth. Considerable pollution is found in the atmosphere over the Central and South American jungles where there is practically no industry.

That a problem exists is now recognized by many technical people. In the United States and Canada today there are over sixty air pollution control bodies working on the problem, but owing to the great increase in mechanization of industry and transportation the progress that is being made is concealed by the greater production of pollutants.

Air pollution control agencies are also hampered by the fact that most of the public has not recognized the fact that in a general way we produce as much pollution as does industry. So far the general public seems to take the attitude that "someone should do something" – someone else that is. This attitude has allowed air pollution control to become a political football, a situation that greatly reduces the efficiency of control agencies. The situation is reminiscent of water pollution control at about the turn of the century.

Those familiar with the history of water pollution control will recall that our cities were beset with violent typhoid epidemics that annually cost thousands of lives, yet since the water supply systems were generally controlled by local politicians nothing was done until the people rebelled.

Today we have safe water supplies and no one thinks twice about the problem, except the engineers and technicians who maintain the purity of the water. Air pollution is sadly in need of a good public relations program to accomplish this necessary public education. In the end it is the public who must spend the money to control air pollution.

The attack on air pollution or "smog" is a two pronged one, performed by two different groups of engineers. One prong is the attack on smog at the source of the pollution where the pollutants are prevented from forming, neutralized, or are reduced before being emitted into the atmosphere. The other prong is the attack at the point of usage of air by the removal of the pollution from air streams that are to be used for ventilating or air conditioning in buildings, thus providing relatively clean air inside. This paper allies with the latter; including warm air heating.

Actually, there is practically no such thing as pure air. Air is a mixture of gases that continually vary in quantity as related to the whole. Oxygen (of greatest interest to people) constitutes about 16% of air but varies in quantity due to the enormous emission of oxygen from growing vegetation, the result

A. J. Hess is President of Hess, Greiner & Polland

of the plant absorbing carbon dioxide from the air, breaking out the carbon for food and returning the oxygen to the air. Since this carbon dioxide is taken from air, it can be concluded that both carbon dioxide and oxygen content in air will vary some. Animals complicate this by taking in oxygen from the air, combining it with carbon and emitting the resultant carbon dioxide into the atmosphere.

However, for the purposes of this paper let us accept pure air as normal atmosphere free of particulate matter and without any detrimental gases.

Particulate matter in the atmosphere is visible with a microscope or, if in sufficient quantity and size, by the naked eye, either directly or by reason of the defraction of the sunlight on the particles, which provides us with a rough scale to judge the amount of this type of pollution. The amount of particulate matter in the air is enormous in terms of the number of particles. In so-called clean air from out in the country there are two to three million particles per cu ft and in heavy industrial areas the count can run as much as thirty million particles per cu ft. These particles are made up of dust, smoke, bacteria, pollen, industrial debris and even water particles. Though these particles exist in great quantities most of them are microscopic in size, which means that the amount of particles by weight is relatively small. Particulate matter in the atmosphere is generally easier to remove than other pollutants, but it should be noted that there is little removal of the great number of small particles. Some of these particles are so small that they never settle out as dust.

The gaseous pollutants are quite as bad or in many cases much worse than the particles but are not as apparent because most pollutant gases are invisible. Gases are also subject to chemical change after emission and many times from an irritant gas out of innocuous gases as given off to the atmosphere. The sun supplies the energy for this photosynthesis.

Some of the usual pollutant gases found in "smog" are: Hydrocarbons, both saturated and unsaturated, which are emitted from vegetation, most combustion processes and automobiles; oxides of nitrogen resulting from the oxidation of nitrogen in passing through any combustion process that utilizes the atmosphere as a source of combustion air; peroxides, ozone and many others including the intermediate semi-gaseous aerosols.

The gases are more of a problem than the particulate matter because detection is difficult and they are probably the most damaging portion of smog. The damage to plant life is well known, and runs into millions of dollars per year. The effect occurs in the leaves which are the manufacturing portions of plants.

Damage to animals is known but not quantitatively. Medical and health authorities are not in agreement but it seems logical that health is affected by air pollutants. The evidence is certainly sufficient to justify air pollution control and smog removal.

Bacteria is another pollutant we know too little about but studies and experiences in hospital operating rooms point out that there is a problem and it is important. Post operative infections of Staphylococci are well known as are the bacteria that cause them. It is still a problem to determine their source; supply air is probably a carrier. Plenty of money is spent cleaning everything else in and about operating rooms, why not the air?

Removing the contaminants from air in air supply systems to buildings has beneficial economic effects in addition to the health consideration. Usually these are sufficient to justify the cost of operation and maintenance of an air filter system.

Outdoor air for buildings is usually provided to dilute or remove odors created by people, food, industrial processes, infiltration of polluted air, smoking or other causes. Ventilation is seldom required to replenish the oxygen consumed by human beings or to remove the carbon dioxide created by human beings because infiltration and exfiltration take care of this. A small amount of outdoor air is usually desirable in order to create a small internal pressure so as to prevent excessive infiltration around windows and doors and large quantities of outdoor air may be used for cooling during certain weather conditions. Also, outdoor air may be required under some circumstances as in schools to dilute or remove the moisture created by the students, but outdoor air should never be required to remove moisture from spaces which are equipped with adequate air conditioning.

Air filtration has been woefully neglected by the air conditioning industry in favor of heating and cooling equipment or, in other words, comfort. I think we should re-appraise this and place proper emphasis on this important health phase of the industry.

Odor Control

H. L. BARNEBEY
Member
ASHRAE

Odor is that property of a substance that affects the sense of smell. Man uses his sense of smell to enjoy, appraise, and detect. Odors can be classified according to reaction on the human nose, chemical composition, or source. The advances of science, industry, and standard of living have brought increased public consciousness of odors. There is now a demand for and an appreciation of adequate odor control. Odors can be eliminated in living and working spaces by dilution with outside air, masking by other odors, and adsorption by activated charcoal. By using an effective method such as charcoal adsorption, enclosed spaces are made more healthful and pleasant; heat is saved in the winter and cooling in the summer, by eliminating the necessity for ventilation with outside air.

An odor is a chemical compound or mixture of compounds in gas or vapor form which affects the nose in such a way as to create the sensation of smell. To have an odor, the substance must have sufficient vapor pressure to give a concentration in air high enough to produce the sensation of odor. Also, the

H. L. Barnebey is Vice President of the Barnebey-Cheney Company

substance must be of such a molecular nature that it gives the reaction of smell to the human nose. Most vapors have odors even though the effect on the nose may not be as serious as the irritation to other parts of the body.

A little odor goes a long way since concentrations of some substances as low as one part in a hundred billion give the sensation of odor. Even below the concentrations which can be recognized as odors, many vapors may cause stuffiness or drowsiness. Odor is an elusive thing. You can not see it, even with the strongest microscope and its weight can be measured only by complicated means. With the exception of a few compounds such as ammonia, all odor producing substances have vapors heavier than air. However, when once thoroughly mixed with air, they do not settle out.

The senses of odor and taste, although separate, are related. They seem to overlap sometimes and confusion can arise. The advances of science, industry, and standard of living have brought increased public consciousness of odors so that there is now a demand for an appreciation of adequate odor control.

Odors can be eliminated in living and working spaces by dilution with outside air, masking by other odors, or absorption by a liquid or solid such as activated charcoal. Dilution is usually expensive because the outside air must be heated in the winter or cooled in the summer. Outside air is frequently not pure and may require treatment to be usable. Masking functions by dulling the sense of smell or covering up one odor with another.

Activated charcoal adsorption is a widely-used method of air treatment which will efficiently and completely eliminate all odor producing substances even though they are present in low concentrations. The contaminated air is passed through a thin layer and emerges free from odor. As charcoal adsorbs odor it increases in weight until its capacity for the odor or mixture is reached, then it must be replaced or regenerated by heat or other means.

Activated coconut shell charcoal will take up about one-fourth to one-third of its own weight of most odors. One pound (about a quart) adsorbs the quantity of odor that the average person breathes in his lifetime. By using an effective method such as charcoal adsorption, enclosed spaces are made more healthful and pleasant; heat is saved in the winter and cooling in the summer, by reducing or eliminating ventilation with outside air.

Charcoal adsorption removes most toxic gases whether they have odor or not. Los Angeles smog has some odor but this is not its most important characteristic. It irritates the eyes and lungs. Frequently the odor of a chemical vapor is only one of its harmful characteristics.

It has not yet been proved that the complete absence of odor is the best atmosphere for human living. Some people think that a delicate fragrance is better than no odor at all. Until we have better proof, it is best to assume that no odor at all is the ideal atmosphere for human occupancy.

The ventilation codes are set up to control odors although this is not always recognized. If the code requires, for example, that 30 cfm per person be used to ventilate a conference room, it means that quantity of air is required to keep the odor at a reasonable level. The sensation of stuffiness frequently is attributed to lack of oxygen. This is definitely not so. Lack of oxygen gives no such sensation. Stuffiness or staleness is due to odors. When these are removed, the air is again fresh.

Here are some suggested specifications for air quality: Absolute pressure, 23-35 in. Hg. Oxygen content, 18-21%. Carbon dioxide, 0.6% max. Dust (and other particulate matter), 0.05 gr/1000 cf max. Bacteria count, 5 per 10 cf max. Odor, 20 ppm max. Toxic vapors, below published limits.

These figures are not presented as a final suggestion. Each of the values must be selected with care and may vary with different types of occupied space and in various parts of the world. It is the principle that I wish to offer. Ventilation, including odor control and other aspects of air purity, should be approached in two steps. First, decide what we want and record it in figures. Second, use the best, most reliable, and least expensive method of achieving these results.

Contaminant Removal

L. C. McCABE Air pollution may arise from natural sources such as volcanos, dust storms, pollen and bacteria and forest fires, or it may be generated by the activities of man in the burning of coal, oil and gas, incinerators, chemical activities, mining and the use of vehicles for transportation.

A recent index of pollutants may be applied to most localities for evaluating the amounts of air contaminants released where controls are not present——

Oxides of sulfur, estimated as SO_2, are emitted from fuel oil combustion at the rate of about 30 lb per 100 lb of oil, coal burning at the rate of about 40 lb per ton of coal, automobile engines at about 17 lb per 1,000 gal of gasoline consumed, diesel engines at the rate of about 15 lb per 1,000 gal of fuel.

Oxides of nitrogen, estimated as NO_2, are produced from fuel oil burning – about 13.5 lb per 1,000 lb of oil, natural gas burning – about 6-9 lb per 1,000 lb of gas, coal burning – 8 lb per ton of fuel, automobile engines – 25-75 lb per 1,000 gal of gasoline used, diesel engines – 75 lb per 1,000 gal of oil burned, waste incineration – about 4 lb per ton of mixed refuse.

Solids, as dusts, smoke, condensed fumes, etc., result from waste incineration at the rate of about 25 lb per ton burned, fuel oil combustion at the rate of about 2.5 lb per 1,000 lb of oil used, coal burning – around 200 lb per ton of fuel, automobile engines – about 0.3 lb per 1,000 gal of gasoline used, diesel engines – about 100 lb per 1,000 gal of oil used.

Aldehydes, estimated as formaldehyde, are emitted by automobile engines at a rate of about 18 lb per

L. C. McCabe is President of Resources Research, Inc.

1,000 gal of gasoline, diesel engines at about 30 lb per 1,000 gal of oil.

Carbon monoxide is produced from gasoline engines in normal operation at the rate of about 3,200 lb per 1,000 gal of gasoline. This is the only really significant source of CO, with the possible exception of improper household heating.

Organic vapors, often referred to as "hydrocarbons," are emitted as pollutants from automobile engines at an average rate of 200-400 lb per 1,000 gal of gasoline used, evaporative losses from automobile carburetors and tanks at a highly variable rate with air temperature – at 100 F the loss may be 2.5 to 5.0 per cent of the gasoline throughput, evaporation losses from the use of organic paint and lacquer thinners, diluents, solvents, degreasing agents, cleaning compounds, and the like can be assumed to equal the amount used, evaporation of gasoline during storage, handling, and marketing is estimated at about 100 lb per 1,000 gal.

Some pollutants which do not come ready-formed from primary sources, but are inter-action products among the primary pollutants under the influence of natural forces in the atmosphere; these are primarily hydrocarbons. In Los Angeles County, approx 1450 ton of hydrocarbons are lost to the air on an average day and 52 per cent of this is attributed to the automobile. The primary source of pollution of Manhattan is also motor vehicle traffic. In the presence of sunlight, the exhaust gases of the automobile are oxidized and form aerosols which may produce smoke screens under certain conditions. In Los Angeles particularly, concentrations of the oxidation products are high enough to cause eye irritation and damage to vegetable crops.

In New York City the Department of Air Pollution collects data with respect to particulate matter in the atmosphere. Here, sootfall averages between 38 and 156 ton per square mile per month. A study of dustfall in Perth Amboy in 1955 showed the average to be 200 ton per square mile per month.

In Hospitals

V. W. GREENE The increased incidence of Staphylococcal complications and postoperative infections reported during the last decade in hospitals on this continent and in the United Kingdom, indicates that closer attention must be paid to the control of all viable airborne contaminants than has been done in the past.

Many attempts have been made during the last 25 years to develop suitable techniques for sampling air for microbial contamination, but to date the problem is far from being solved satisfactorily. Tables of representative data on the airborne bacterial count in hospitals show the count per cu ft to run as high as 2,000 in a ward during bed-making; from 20-619 in an ordinary ward; from 20 to 1000 in a pediatrics isolation area, etc. These ranges are quite variable and dependent on many factors. However, they do illustrate the relative number of bacteria encountered in different environments. There is no doubt that contaminated air is one of the many factors influencing the occurrence of cross infection.

The ultimate solution to hospital cross infection will require the cooperation of many related disciplines, such as hospital administrators, housekeeping and custodial staff, and the serious consideration of engineers, hospital designers and builders.

Apparent sources of the bacteria in the air area: outside air which is itself contaminated in varying degrees; the fomites of the hospital environment – floors, furniture, bedding, etc.; and, of course, infected people, both patients and visitors in the hospital. Probably the biggest factor leading to the dissemination of bacteria from both people and fomites is the degree of associated activity. A highly active person who moves vigorously will contribute more bacteria to the air than a person who moves slowly and deliberately. Four people walking through a hallway contribute more bacteria than one person.

Just as we protect critical hospital areas from unwanted visitors by doors and barriers, so must we protect these areas from unwanted bacteria by planned airflow patterns. One must consider each hospital area and design the ventilation specifically for that area.

For example, in a nursery or delivery room where uncontaminated air would be most desirable, the air pressure should be greater than that in the nearby hallways to minimize movement of contamination from the latter source. On the contrary, a similar system installed in an isolation ward might endanger everyone in the surrounding area by pushing pathogens from already infected patients out of the rooms into the hallways. Under special conditions, air lock arrangements might be used to maintain proper pressures and prevent the movement of contaminated air into areas where it presents a hazard.

The forces which influence airflow must also be considered in ventilation design. These institutions are literally honeycombed with chutes, stairwells, elevators, duct shafts, conduits and other pathways suitable for transport of microbe laden air. It is not sufficient to consider bacterial transport merely by studying floor plans – the over-all structure must be kept in mind.

Also, a hospital ventilation system should be designed to eliminate these bacteria, rather than merely push them around. One way in which this can be accomplished is by dilution of contaminated air with pure air. Contaminants can be quickly removed by ventilation providing 18 air changes per hour, and almost instantly removed during 75 air changes per hour. More work should be devoted to arriving at a sound basis for optimum ventilation rates, however, before any generally applicable values are accepted.

A refinement of the dilution method is the so-called "piston" effect which introduces supply air over the total ceiling area and forces it to move uniformly toward the floor, where it is exhausted. This system, however, poses some new design problems such as the optimal configuration of the space in order to enhance the piston effect.

To be sure that supply air is really clean, it is

V. W. Greene is Assistant Professor of Public Health and Bacteriologist, University of Minnesota.

generally agreed that it should be treated in some manner to reduce its bacterial count. While no standards have been established in this field, it is possible on the basis of experimental trials to obtain counts consistently less than ½ bacteria per cu ft by treating incoming air with commercially available air cleaning systems, such as mechanical and adhesive filters, chemical germicides, ultraviolet radiation and electronic air cleaners. Each of these systems has its own advantages and its own drawbacks, the latter being susceptible to improvement by further research and development.

Perhaps someone will work out the ideal air purification system, using a combination of the different systems already available, arranging components so that the supply air into a space will be bacteriologically clean as well as fresh. All this can be accomplished if doctors and nurses, bacteriologists, engineers, architects and builders join forces.

Total Air Treatment

W. L. McGRATH
Member
ASHRAE

From the previous speakers on this panel you have heard an excellent commentary on the difficulties that beset us in the area of air cleaning and purification. I raise this question: To what concepts in air treatment and building design does this background lead us?

The answer encompasses two inescapable propositions:

Design that contemplates the substantial exclusion of outside air from our living and working areas beyond the quantity required for physiological reasons.

Total treatment of the air in the spaces in which we live and work.

I think present standards of ventilation were set back in the dark ages i.e., before air conditioning. The function of ventilation then was cooling. Before air conditioning, this was the only means of alleviating what would otherwise be insufferably high temperatures. This fetish has affected the design of our buildings long after the means was available to eliminate the problem. Large and small buildings have been and still are being wastefully designed in the shapes of L's, O's, H's, U's, E's and T's, a veritable alphabet soup—largely for the purpose of providing "cross ventilation." Even house design is hamstrung by the same tradition.

At this stage in our technology I can see only one major function for ventilation (meaning the deliberate admission of outside air beyond specific physiological requirements). That is for the diluting of odors. And I am sure when you leave this conference, you will agree with me that even this justification could be an anachronism.

What do I mean by the "total treatment" of air?

1. Heating when needed and to the degree needed.
2. Cooling when needed and to the degree needed.
3. Humidifying when needed and to the degree needed.
4. Dehumidifying when needed and to the degree needed.
5. Constant removal of dirt and dust (much less of a problem when we keep the dirty outside air out).
6. Constant removal of pollen, spores, and other allergens.
7. Constant removal of odors created within the space.
8. Constant removal of airborne bacteria and virus organisms. (In addition to the danger of radioactive contamination, we have possible pollution by germ warfare.)
9. Constant removal of air contamination due to leakage of outside air into the building.

This makes a quite specific list. Yet, in the future perhaps other functions might be added. All of these, however, will rely on the ability of the building to purify the air contained within it. A controversial example is the question of ion polarity. I think it important that we get better evidence about it.

How close are we to realizing total treatment?

1. Heating and cooling equipment available today is excellent. There is no reason for any structure not being totally air conditioned.
2. Dehumidifying we mentioned fortuitously comes along as a bonus with good summer cooling.
3. Humidification—not too much of a problem—but the means of adding humidity can be improved and certainly the building construction must be re-examined if we are to maintain desired levels of relative humidity in colder climates.
4. Equipment for air cleaning is again excellent, although some improvement could be contemplated to make it more service-free, particularly in homes and smaller buildings.
5. As to pollen, spores and allergens, you may be surprised to know that these aerialists are easily removed. Even with average filter mediums (provided the space is air conditioned so that occupants do not resort to open windows) it has been proven that the pollen count is reduced to one or two per cent of that existing outdoors, well below the threshold of irritation for most people.
6. Removing odors? Effective equipment is available. While satisfactory, some additional improvement of equipment in the direction of making it more service free is indicated.
7. As to outside contamination, the smog and the aerial garbage from civilization, we have accomplished most of this job by controlling internal odor level thereby making it unnecessary to bring in any quantity of this contaminated air.
8. As to bacteria and virus organisms, we have good evidence that the better types of filtration equipment do an excellent job of removing such airborne organisms. Having removed them, it is probably desirable to kill them, but evidence also indicates that this can be accomplished. Certainly it remains for the medical profession to document

(*Continued on page* 114)

W. L. McGrath is Chief Engineer, Unitary Equipment Div, Carrier Corporation.

British Columbia Chapter plays the host, so it is

Vancouver calling you

For three days, June 13-15, the ASHRAE British Columbia Chapter will be host to the American Society of Heating, Refrigerating and Air-Conditioning Engineers for its 67th Annual Meeting at Vancouver, B. C. Headquarters for the event will be at the Vancouver Hotel.

As is customary, new officers will be installed at the Welcome Luncheon, on Monday, June 13. Under the Plan for Consolidation, Walter A. Grant will succeed D. D. Wile as President; R. H. Tull will become First Vice President; and John Everetts, Jr., will be Second Vice President. As official nominee, it is likely that John E. Dube will become Treasurer.

A comprehensive and varied technical program has been arranged for this gathering. As indicated below, there will be four Technical Sessions, with 15 papers scheduled for presentation; two Symposiums covering Domestic Refrigerator Engineering and Commercial Refrigeration; and seven Forums. Abstracts of papers to be presented at the Technical Sessions and Symposiums appear on later pages of this issue.

Social events include get-together meetings, a 5-hour cruise by steamship through nearby bays and harbors of long-famed beauty, and the annual banquet.

Side trips to points of local interest, to Alaska, Lake Louise, Emerald Lake, Banff, Jasper and the whole Pacific Northwest are quite feasible.

Here is an outline of the program.

First Technical Session

A Gas-Fired Open Cycle Air Conditioner—B. E. Eakin, Supervisor, Reservoir Engineering Research, and R. T. Ellington, Assistant Research Director, Institute of Gas Technology.

An Air-Cooled Absorption Cycle—R. H. Merrick, Chief Engineer, and R. A. English, Senior Development Engineer, Bryant Manufacturing Company.

The Dual Solution System—F. H. Hibberd, Air Conditioning Development Co.

Solar Heat Gains Through Slat-Type, Between-Glass Shading Devices—N. Ozisik, formerly ASHRAE Research Lab., and L. F. Schutrum, ASHRAE Research Lab.

Second Technical Session

A Proposed Pipe Friction Chart for High Temperature Water Systems—T. C. Min, Professor, and P. J. Potter, formerly Head, Dept. of Mech. Engrg., Auburn Univ.

Reaction Forces in a Scotch Yoke—V. G. Foris and B. W. Hatten, Refrig.-Freezer Engrg. Dept., Westinghouse Electric Corp.

Electrical Analogy of Basement Heat Loss—J. M. Elliott, Assistant Professor of Mech. Engrg., University of Kentucky, and Dr. Merl Baker, Director, Kentucky Research Foundation.

Cooling Rates of Apples Packed in Different Bushel Containers and Stacked at Different Spacings in Cold Storage—D. V. Fisher, Head, Pomology Section, Department of Agriculture, Canada.

Third Technical Session

Solubility of Refrigerants 11, 21, and 22 in Organic Solvents Containing an Oxygen Atom—L. F. Albright, Professor, School of Chemical Engineering, T. C. Doody, Assistant Professor, School of Chemical Engineering, P. C. Buclez and C. R. Pluche, Graduate Students, Purdue University.

Determination of Moisture in Fluorocarbons—J. D. Morton and L. K. Fuchs, Development Dept., Union Carbide Chemicals Co., Div. of Union Carbide Corp.

A Study of the Factors Influencing the Stability of the Mixtures of Refrigerant 22 and Refrigerating Oils—Dr. W. O. Walker, Dean, Div. of Research & Industry, S. Rosen, Industrial Chemical Research Lab., Univ. of Miami, and S. L. Levy, Research Lab., Allied Chemical Corp.

Time Factors in the Removal of Moisture from Refrigerating Systems with Desiccant-Type Driers—Walter O. Krause, Section Head, Refrigeration Applications Research, Arthur B. Guise, Director of Development and Design, and Edward A. Beacham, Manager, Refrigeration Sales Development, Ansul Chemical Co.

Fourth Technical Session

Production Control Testing of Thermoelectric Materials—G. V. Downing, Jr., Merck, Sharp, and Dohme Research Lab.

A Simplified Engineering Approach to Thermoelectric Heat Pumping—W. V. Huck, Electrical Products Lab., Minnesota Mining and Mfg. Co.

A Comparative Study of the Manufacturing Costs of Thermoelectric and Mechanical Refrigerating Systems—D. W. Scofield, P. F. Taylor, and L. A. Staebler, Manager, Advanced Development Dept., Philco Corp.

Commercial Refrigeration Symposium

Chairman—J. H. Rainwater, Director of Engineering, Warren Company, Inc.

Effects of Air Conditioning on Condensing Unit Sizes for Open Display Equipment and the Air Conditioner Itself—D. E. Friedman, Chief Engineer, Hussmann Refrigerator Co.

Air Conditioning in Food Stores and Its Effect on the Operation of Open Display Equipment—T. L. Tyler, Product Development Engineer, Tyler Refrigeration Corp.

Condensation In and On Open Display Equipment as Related to Air-Conditioned vs. Non-Air-Conditioned Stores—J. A. Biggers, Director of Engineering, Friedrich Refrigerators, Inc.

Domestic Refrigerator Engineering Symposium

Chairman—H. P. Harle, Household Refrigerator Dept., General Electric Co.

Keynoter—Glenna McGinnis, Food and Equipment Editor, "Woman's Day"

Underwriters' Requirements for Refrigerators and Freezers—George H. Pope, Managing Engineer, Casualty and Automotive Dept., Underwriters' Laboratories, Inc.

Forums

Cryogenics—Moderator, V. J. Johnson, Cryogenics Engrg. Lab., U. S. Dept. of Commerce, National Bureau of Standards.

Aluminum Tube Refrigeration Coils—Moderator, O. J. Nussbaum, Chief Engineer, Kramer-Trenton Co.

Corrosion with Window Air Conditioners—Moderator, C. O. Hutchinson, Glidden Co.

Reducing Power Needs for Hot Water Systems—Moderator, C. W. Pollock, Air Conditioning & Refrigeration Div., Crane Co.

Practical Application of Foam Insulation—Moderator, V. L. Miller, Assistant Mgr., Technical Services Dept., Pittsburgh Corning Corp.

Noise in Ventilating Systems—Moderator, J. B. Graham, Buffalo Forge Co.

Economics of Electric Heating vs. Fossil Fuels for School Buildings—Moderator, L. Bouillon of Bouillon, Griffith, Christofferson & Schairer.

for June 13-15

AUGUST ISSUE ——

News highlights and summary of the 67th Annual Meeting in Vancouver, B.C. Reviews of significant points brought out in technical session papers and at the Commercial Refrigeration and Domestic Refrigerator Engineering Symposiums. Included will be news pictures taken during the technical program and at social events.

ABSTRACTS OF TECHNICAL AND SYMPOSIUM PAPERS

FIRST TECHNICAL SESSION—MONDAY, JUNE 13, 9:30 A.M.

Gas-fired open cycle air conditioner

B. E. EAKIN
Supervisor
Reservoir Engineering Research
Institute of Gas Technology

R. T. ELLINGTON
Assistant Research Director
Institute of Gas Technology

Air conditioning by liquid-desiccant-drying and adiabatic partial-resaturation of circulated air has aspects of continued interest to designers of commercial and industrial systems. In such a unit relative humidity as well as temperature of the air can be controlled, and dust and odors are effectively removed in the dual washing the air receives. A particular advantage for small commercial or domestic applications is the ease with which an open-cycle system can be adapted to year-round operation providing summer cooling and winter space-heating, with complete humidity control.

Thermodynamic calculations on open-cycle liquid-sorbent air-coolers for various operating conditions indicated that net thermal efficiencies of 37 to 57% could be obtained, depending on cycle conditions. These were based on use of tri-ethylene glycol as the sorbent. A pilot model of 300 cfm nominal capacity was designed, constructed and operated. General physical dimensions and thermal efficiency for a domestic 3-ton unit were calculated, based on results of experimental data, and indicated that up to 44% net thermal efficiency should be attainable by this type unit.

An air-cooled absorption cycle

R. H. MERRICK
Member ASHRAE

Chief Engineer
Gas Air Conditioning
Bryant Manufacturing Company

R. A. ENGLISH
Member ASHRAE

Senior Development Engineer
Gas Air Conditioning
Bryant Manufacturing Company

A newly developed air-cooled absorption cycle being used in 3 and 4½ ton gas-fired air conditioning equipment is described.

Ammonia-water is the refrigerant-absorbent combination. Unusual features of the cycle are the use of a hermetic transfer device to circulate solution and a solution-cooled rectifier piped in parallel with the heat exchanger to improve cycle efficiency.

Calculations are presented indicating the cycle COP, the transfer device thermal energy requirements and the efficiencies of the key cycle heat transfer devices.

A cycle diagram and functional description are included.

Certain performance and operating data will be shown by the authors.

Dual solution system

F. H. HIBBERD

President
Air Conditioning
Development Company

This paper describes and discusses a variation from conventional air conditioning methods. The dual solution system is basically of the open absorption type but utilizes two solutions, thereby achieving certain advantages but at the cost of increased complexity and bulk.

The primary solution which conditions the air by direct contact is of relatively low hygroscopic strength but is continuously cooled so that it cools as well as dehumidifies the air. The secondary solution absorbs water vapor from the primary solution, thereby restoring it. A vacuum chamber, an evaporative condenser-like apparatus and a double effect evaporator are used to restore the secondary solution. Heat is supplied to the evaporator by oil or gas fuel.

By a shift of valves and dampers the same equipment can be made to cool and dehumidify or alternatively to heat and humidify.

A 5-ton experimental unit has been under test and development for several years. Preliminary tests indicate the feasibility of operation including reasonable avoidance of corrosion. Lithium chloride has been used so far but other hygroscopic materials are possibilities.

Principal advantages are low operating cost and independent control of temperature and humidity within limits. Development has not yet been carried far enough to clearly define probable scope of application but the system has potential advantages which should make it of interest to the air conditioning engineer.

Solar heat gains through slat-type between-glass shading devices

N. OZISIK

Formerly
ASHRAE Research Laboratory

L. F. SCHUTRUM

Member ASHRAE
ASHRAE Research Laboratory

Various shading devices were tested in the ASHRAE Solar Calorimeter under natural weather conditions to determine instantaneous solar heat gains. Commercial devices tested consisted of slat-type sunscreens positioned between two sheets of window glass, (1) in contact with both sheets of glass, (2) in contact with both sheets of glass and having the sunscreen embedded in plastics, or (3) with a small air space between shade and glasses. Venetian blinds installed between glass were included.

The theory of solar radiation transfer through slat-type shades was extended to include the "between glass" condition and the theoretical calculations were verified by the experimental results.

K factors were developed from the theory and these factors multiplied by the intensity of the solar radiation give the instantaneous heat gain by the room from the sunlit window. U-values are given to provide the means for determining heat gains or losses resulting from outdoor-indoor temperature differences. Use of these slat-type between-glass shading devices results in a considerable reduction of the instantaneous solar heat gains as compared with a window of single glass.

A proposed pipe friction chart for high temperature water systems

T. C. MIN

Associate Professor of
Mechanical Engineering
Auburn University

P. J. POTTER

Formerly Professor and Head,
Dept. of Mechanical Engineering
Auburn University

A new multi-purpose friction chart for high temperature water systems has been prepared. Illustrations of the use of chart will be presented. Currently available friction factor data and friction charts will be compared and discussed.

The friction chart is a fundamental tool for designing any fluid system. Especially in a high temperature system, it is almost indispensable due to the wide range of water temperature and density. Friction losses for 300 F water, for instance, flowing through a 3-in. pipe at a mass flow rate of 20,000 lb_m/hr differs from that for 500 F water flowing through the same size of pipe at the same mass flow rate because of differences in the thermal-physical properties of the water. Likewise, for the same pipe and velocity, mass flow rate of 300 F water differs from that for 500 F water.

Since calculation of friction losses for a wide range of temperature, velocity and pipe sizes is tedious and troublesome, the need of a friction chart becomes apparent.

Reaction forces in a Scotch yoke

V. G. FORIS

Refrigerator-Freezer Engineering Dept.
Westinghouse Electric Corp.

B. W. HATTEN
Member ASHRAE

Refrigerator-Freezer Engineering Dept.
Westinghouse Electric Corp.

Scotch yoke is a time-honored simple mechanism for converting rotational to reciprocating motion. Its chief characteristics are that it provides simple harmonic motion with respect to crank rotation, and is capable of accommodating relatively large variations in perpendicularity between the cylinder bore and crankshaft.

The yoke has found its way into countless applications, but this paper is primarily concerned with small compressors used in household refrigerators and freezers. Specifically, the objective here is to reduce the magnitude of the restraining loads on the piston and other parts of the Scotch yoke, and thus minimize noise, wear and power consumption.

This analysis is relatively straightforward, but numerous combinations of variables and complexities introduced by friction characteristics made extensive calculations necessary. Such work is not only tedious, but involves a high probability of error. Consequently, use was made of a digital type electronic computer (in this case an IBM 704) to accomplish a thorough investigation with accuracy and in a short time. Use of the computer also means that new questions covered by the existing program can be resolved promptly.

The practicality of the computer application is further evidenced by the fact that after the initial set-up and confirming runs, new cases with revised data were run in 5.7 sec each at a cost of approximately 53 cents, as compared with several hours of manual calculation.

NEWS REPORT In the August issue of the ASHRAE JOURNAL will appear full news of the 67th Annual Meeting with pictures of highlights of technical sessions and social events.

Electrical analogy of basement heat loss

J. M. ELLIOTT

MERL BAKER
Member ASHRAE

Assistant Professor
Mechanical Engineering
University of Kentucky

Director
Kentucky Research
Foundation

Conductive sheet models, constructed from commercially available electrical conducting paper, are used to evaluate the steady state heat loss from basements with walls having thermal conductivities of 0.25 and 1 Btu/hr/ft²/F. Design conditions are 70 F inside temperature and 0 F outdoor air temperature.

Heat loss per foot of perimeter and the shape factor are presented for the basements studied. The temperature field in the basement wall and surrounding soil is plotted for steady state conditions. The electrical analog solution is compared to results of graphical and numerical analysis.

Cooling rates of apples packed in different bushel containers and stacked at different spacings in cold storage

D. V. FISHER

Head, Pomology Section
Research Station
Canada Department of Agriculture

A comparison was made of cooling rates of apples in wood and cardboard (cell and tray) cartons. The experiments included container spacing tests, use of vented containers, and were conducted in cold storages employing single stack as well as pallet load handling. In single container trials, center package fruit temperatures in both wood and cardboard containers dropped from 65 F to 33 F in 80 hr, where free air movement was allowed on all sides of packages. In stack and row spacing experiments, good, fair and poor spacing required, respectively, 8.3, 9.7 and 10.5 days to reduce fruit to equilibrium temperatures of 32.4 F, 32.7 F and 33.0 F. Top boxes in stacks cooled significantly faster (1.5 days) and to slightly lower final temperatures than center boxes in stacks.

Differences in cooling time and in final equilibrium temperatures, under commercial storage conditions, were significantly different in some cases between wood and cardboard containers and between vented and unvented containers. In commercial palletized storage trials, containers stacked solidly on pallets took twice as long to cool to 32 F as similar containers stacked loosely to provide air circulation. Furthermore, equilibrium temperature of fruit in solid pallet loads was 0.5 F higher than in spaced loads.

THIRD TECHNICAL SESSION—WEDNESDAY, JUNE 15, 9:30 A.M.

Solubility of Refrigerants 11, 21, and 22 in organic solvents containing an oxygen atom

Solubility information of refrigerant gases in solvents is of importance in selecting suitable chemical combinations for absorption refrigeration systems. A systematic investigation was made to determine the solubility of Refrigerants 11, 21, and 22 in several types of polar organic solvents, which contain an oxygen atom, at temperatures from 75 to 250 F and at pressures up to those approaching the vapor pressure of the refrigerant.

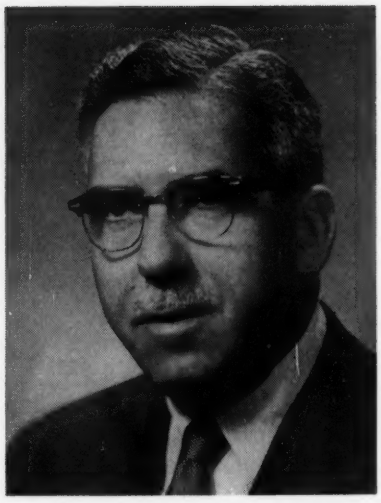
Refrigerant 11 (CCl_3F) was found to be less soluble in all solvents investigated than would be predicted from ideal solution considerations, i.e. the solutions showed positive deviations from Raoult's law. Refrigerants 21 ($CHCl_2F$) and 22 ($CHClF_2$),

WALTER A. GRANT

First Vice President
and President-Elect

DAN D. WILE

President



WHEN ASHRAE HOLDS ITS ANNUAL MEETING IN VANCOUVER

however, have negative deviations from ideality with esters, ethers and carbonyl compounds indicating solubilities greater than predicted by Raoult's law; nevertheless, both refrigerants had positive deviations with some acids and with the alcohols, glycols, and glycerine. Hydrogen bonding is important in all systems studied and helps explain the solubility characteristics noted.

Magnitude of the solubilities of refrigerants depends primarily on the polar groups of the solvent plus to some extent the atomic arrangement of the molecule. The following list is arranged in order of the general decreasing refrigerant solubility: dimethyl ether of tetraethylene glycol, esters, ketones, aldehydes, acids, alcohols, and glycols. On the basis of solubility results, the dimethyl ether of tetraethylene glycol is a promising solvent for refrigeration purposes.

L. F. ALBRIGHT
Member ASHRAE

Professor
School of Chemical Engineering
Purdue University

T. C. DOODY, Assistant Professor, Chemical Engineering

P. C. BUCLEZ, Graduate Student

C. R. PLUCHE, Graduate Student

Purdue University

Determination of moisture in fluorocarbons

J. D. MORTON

LAURA K. FUCHS

Development Dept
Union Carbide Chemicals Co.
Div of Union Carbide Corp.

Usual methods of analysis for determining trace amounts of water in refined fluorocarbons are either too time consuming for routine analyses or lack the required sensitivity for determining water in the 1 to 20 ppm range. A method of analysis has been developed, utilizing a dilute Karl Fischer reagent, a cooled pressurized titration flask and an electrometric end point, which effectively overcomes both of these shortcomings.

This method, after preliminary standardization

R. H. TULL
Second Vice President

J. EVERETTS, JR.
Third Vice President

F. Y. CARTER
Treasurer

S. J. WILLIAMS
Program Chairman
Chairman, First Session

R. A. LINE
Chairman, Second Session

G. F. CARLSON
Chairman, Third Session

R. S. BUCHANAN
Chairman, Fourth Session

and preparation of equipment, can be performed in a routine analytical laboratory in approximately fifteen minutes per determination. It has been found suitable for analyzing fluorocarbons 11, 12, 22, 113 and 114 and should be applicable to other fluorocarbons and related compounds. The average standard deviation of the procedure is 0.6 ppm, and the accuracy is ± 1 ppm water in the 1 to 20 ppm range.

On the basis of results obtained, the procedure is recommended for routine analysis of fluorocarbons for water. It is believed that use of the method is advantageous from the standpoint of accuracy, precision, ease of performance and analytical time required.

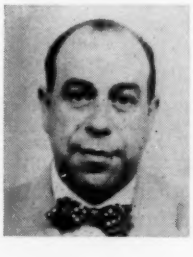
A study of the factors influencing the stability of the mixtures of Refrigerant 22 and refrigerating oils

WALTER O. WALKER
Member ASHRAE

Dean, Div of Research
and Industry
University of Miami

SHELVIN ROSEN

Research Instructor
University of Miami



SHERMAN L. LEVY

Research Chemical Engineer
General Chemical Div
Allied Chemical Corp.

This paper is the first in a series reporting on a broad study of factors influencing the stability of fluorocarbon refrigerants and refrigerating oil mixtures. Refrigerant 22 is the specific refrigerant discussed at this time.

Seven identical samples, 90 different combinations of Refrigerant 22, oil, water, air and metals were prepared in sealed glass tubes. Three samples of each combination were tested at 250 F and three at 375 F. Observations in both liquid and vapor phases were made for viscosity change, sediment, wall deposit and varnish, corrosion of metals and copper plating. Color development in the refrigerant-oil mixture was also recorded. Observations were made according to a prearranged time schedule with the final observation being made after the tubes had been on test for 360 days.

IBM data processing procedures were developed

to provide a mechanical means for handling and sorting data.

Results are presented in bar graphs and curves. A summary of conclusions showing the influence of oil, water, air and metals on wall deposit and varnish, corrosion, copper plating and color is given. Air, high temperature and liquid water have the greatest effects.

Time factors in the removal of moisture from refrigerating systems with desiccant type driers

WALTER O. KRAUSE
Affiliate ASHRAE
Section Head
Refrigeration Applications Research

ARTHUR B. GUISE
Member ASHRAE
Director of Development and Design

EDWARD A. BEACHAM
Member ASHRAE
Manager
Refrigeration Sales Development

Ansul Chemical Company

It is recognized that the drying of refrigerating systems by means of desiccant type driers is not an instantaneous process. Moisture from all internal parts of the system must be transferred to the drier by the refrigerant. This paper discusses the effects of some of the variables which influence the rate at which these systems are dried. Factors studied include the influence of rate of refrigerant flow and by-pass drying, internal surface area and drier size on system drying time.

With drier size and rate of refrigerant flow held constant, increases in internal surface area will result in increased drying time. At a given rate of refrigerant flow and internal surface area, drying time can be reduced by increasing the drier size. Holding the drier size and internal surface area constant, drying time can also be reduced by increasing the rate of refrigerant flow. By installing the drier in a by-pass the rate of refrigerant flow through the drier is decreased. Accordingly, the drying time is increased in specific instances.

Curves for the drying process were obtained using the electrolytic water analyzer. The curves of the drying process for the experimental equipment were found to be similar to those obtained from operating refrigeration units.

FOURTH TECHNICAL SESSION—WEDNESDAY, JUNE 15, 9:30 A.M.

Production control measurements on thermoelectric materials

GEORGE V. DOWNING, JR.

Physical and Inorganic Chemical Research
Merck, Sharp and Dohme Research Laboratories

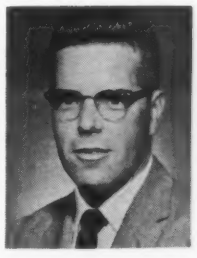
Methods and apparatus used to measure parameters entering into the figure of merit ($Z = \frac{S^2}{pk}$) are described. Resistivity (p) is measured by a two point probe method using 1000 cycle ac. The voltage drop between the probes is amplified and measured with an ac vacuum tube voltmeter. The Seebeck coefficient (S) is measured by contacting one end of the sample with a heater and measuring the Seebeck voltage and temperature difference between the ends of the sample.

Thermal conductivity (K) is measured by a steady state method in which the sample is placed on a cold sink maintained at 0°C by means of an ice bath, and a small cylindrical heater is placed on top of the sam-

ple. Thermocouples are placed in the sink and the heater close to the ends of the sample, and sufficient current is applied to the heater to maintain it at room temperature. From the known resistance of the heater and the measured current, the amount of heat can be calculated; and together with the measured temperature difference between the ends of the sample and its geometry, the thermal conductivity may be calculated.

The apparatus in each method is designed for the handling of many samples which are submitted to a control laboratory, with emphasis given to obtaining a satisfactory measurement in a minimum time. The accuracy of each measurement is $\pm 3\%$ with a precision of $\pm 2\%$ in the case of the thermal conductivity and somewhat better for the Seebeck coefficient and resistivity.

A simplified engineering approach to thermoelectric heat pumping



W. V. HUCK

Thermoelectric Products
Minnesota Mining
& Manufacturing Company

During the past several years, a great deal of interest has been shown in the field of thermoelectricity, both in the conversion of heat into electricity and in the pumping of heat by thermoelectric means. This interest has been brought about by the discovery of new semiconducting compounds which are far superior in performance to the metals previously used. Many advantages of successful utilization of these materials are apparent. Refrigerating devices can now be constructed having no moving parts, thus they are silent and maintenance free. There is no known reason for limiting the life expectancy of such systems. Thermoelectric heat pumps are reversible and, therefore, can be used to heat as well as cool merely by changing the direction of the current flow.

With the latest experimental data it is possible to estimate the feasibility of applying thermoelectricity to the solution of heat transfer problems with the use of a linear equation relating heat load and temperature difference. Although large thermoelectric refrigerating units are as yet not available, there are several areas where this new system can make noteworthy contributions.

A comparative study of the manufacturing costs of thermoelectric and mechanical refrigerating systems

D. W. SCOFIELD

Project Engineer

P. F. TAYLOR

Project Scientist

L. A. STAEBLER

Member ASHRAE
Manager

Advanced Development Department, Appliance Division, Philco Corporation

The purpose of this study is to compare the manufacturing costs of thermoelectric and mechanical refrigerating systems for various design capacities. In order to permit this comparison a relationship between cost and heat pumping capacity is developed for the thermoelectric system by writing a cost equation for the complete TE system, including power supply, thermoelectric couples and heat exchange surfaces. The variables involved include total Btu/hr design capacity, TE material parameters, operating current and the geometry of the thermoelectric couple. From this equation a relationship between couple geometry and the operating current for minimum cost is obtained. Then, by selection of various operating currents, an absolute minimum cost is deduced. This also permits one to relate manufacturing cost with COP so that a unit can be designed either for absolute minimum manufacturing cost or for a compromise between absolute minimum cost and maximum COP.

The cost of the TE materials used in establishing the relationship is somewhat below the present market price. However, it is one which companies presently

engaged in the fabrication of such materials considered to be attainable within the next few years. Other costs are based upon present day technology of TE couple fabrication and upon conventional design of the dc power supply. If significant advances are made in the Z factor of the TE materials and in couple fabrication, either of which will permit the use of less TE material for the same performance, then thermoelectricity will be more competitive than this study indicates. Further cost reduction may likewise be possible in the dc power supply.

Use of thermoelectricity for military and other special applications is rapidly increasing. This is evidenced by the government support enjoyed by many companies working in this field. In the consumer appliance industry economic factors become of prime importance. However, despite the compe tition of the low cost mechanical refrigerating system, thermoelectricity may have applications in the near future for devices of capacities up to 200 Btu/hr, and within just a few years thermoelectric refrigerators of up to 4 cu ft may be available to the public in commercial quantities. It does not appear that thermoelectricity will in the foreseeable future completely replace or make obsolete the mechanical system; however, there are reasons to expect that continued research will eventually provide a combination of improved thermoelectric materials, simplified manufacturing techniques, and low cost power supplies which will make thermoelectric refrigeration economically competitive with mechanical refrigeration for larger major appliances.

DOMESTIC REFRIGERATOR ENGINEERING SYMPOSIUM—MONDAY, JUNE 13, 9:30 A.M.

Human engineering, and its demands on refrigerator design

HAROLD P. HARLE

Presiding Chairman

The refrigerator and freezer design engineer is not the one who actually designs these appliances, but instead works to a set of specifications which have in reality beset many other people.

A number of factors which influence these specifications that the designer must then meet will be discussed in this Symposium. Human engineering is only one of the factors to be considered, since the product must be made simple enough that the consumer can be taught to use it, even though technically it may be far beyond the average housewife's comprehension. Usually these specifications for physical arrangement and styling are given to the design engineer by the industrial designer, and the Symposium panel will include a member from this field.

Codes and standards contribute to another group of specifications the engineer must consider. Two well-known organizations which engaged in establishing and checking these standards are Underwriters' Laboratories and Canadian Standards Association, both of which will be represented on the panel.

Of course, the most important specifications for the engineer to meet are those which are set by the customer. To discuss the homemaker's thoughts, and to keynote the Symposium, the program will include the editor of a well-known woman's magazine, who is qualified to speak with the authority of both an editor and a homemaker.

The fourth group participating will represent one of the independent organizations which conducts various tests on appliances and publishes its evaluations in bulletins which are sold to the public. Test methods and facilities, and criteria for evaluation will be discussed.

GLENNA McGINNIS

Keynoter

Food and Equipment Editor
Woman's Day Magazine

I hope to speak as an Equipment Editor and a homemaker. It is also my intention to speak for some other equipment editors and homemakers. As a result of a survey of my own, made for this occasion, I would like to evaluate current refrigerators and freezers—with special emphasis on their features which have been well accepted—then discuss their weaknesses or poor features. Then I would like to make a plea for some features which my experiences and my study show are wanted.

I propose to discuss the aims, goals and responsibility I feel the engineers should have in designing and producing refrigerators and freezers for Mr. and Mrs. America.

In my opinion, it is increasingly important that these appliances be designed for service from the front or all should be put on working rollers so they can be pulled out for servicing without gouging floor coverings. This feature will enable the homemaker to clean behind her refrigerator or freezer.

I am against this custom of a new or supposedly new model being forced

each year and hope others will follow the lead of the bell cow now skipping this practice.

Then I will have things to say about the way I think these appliances should look, inside and out, the way they should sound, and behave; the way they should be easy to clean; the way they should not fall apart, but if and when they do, a workable way can be put back together. I will also comment about interior colors and the often frustrating slots, containers and traps for what the manufacturer believes every homemaker constantly keeps in them.

I intend to make a plea for simplicity.

Underwriters' requirements for refrigerators and freezers

Underwriters' requirements as they apply to Underwriters' Laboratories approval of refrigerators and freezers, including descriptions of how specifications are established and how tests are conducted will be discussed. Additionally, U.L. opinions regarding various materials, such as plastics and foamed insulations, as well as some of the electrical standards which have been arrived at, will be brought out during the course of this Domestic Refrigerator Engineering Symposium. Finally, general suggestions for improvements in design, or better communications between the Laboratory and manufacturers will be commented upon.

G. H. POPE
Managing Engineer
Casualty and
Automotive Dept.
Underwriters'
Laboratories, Inc.

COMMERCIAL REFRIGERATION SYMPOSIUM — TUESDAY, JUNE 14, 9:30 A.M.

The effect of air conditioning in food stores on the operation of open display equipment

J. H. RAINWATER
Presiding Chairman

It has become apparent that more coordination is required between the Air Conditioning Engineer and the Refrigerating Engineer in the design of modern day supermarkets. Due to the ever-increasing number of open display refrigerators installed in supermarkets, the cooling loads become dependent on one another. Air conditioning grille outlet locations, having a direct effect upon the refrigerator operation, need to be planned in the beginning with the open case in mind. It is felt that this Symposium will help to bring out the various effects air conditioning has on open refrigerated display cases.

Air conditioning in food stores and its effect on the operation of open display equipment

An improperly air-conditioned supermarket can greatly hinder the operation of the refrigerated display equipment, resulting in high operating costs and possibly even improper product temperature.

Location and design of air grilles are critical, as drafts must not be allowed to impinge on the refrigerated display area.

Design of the air-conditioning system must take into account the reduction of the heat load caused by the display equipment. An extreme humidity problem can be incurred with an oversized system as the open refrigerators remove mainly sensible heat.

T. L. TYLER
Associate ASHRAE

Product Development Engineer
Tyler Refrigeration Corp.

The inherent characteristics of "swamp cooler" type air-conditioning systems can often penalize open display fixtures and great care must be exercised in the adoption of such systems to supermarkets.

New vertical display open refrigerated equipment concentrates radiant heat removal from nearby areas. Care must be taken to avoid customer discomfort by overcooling these areas.

Inter effects of air conditioning and open display refrigerators

DONALD E. FRIEDMAN
Associate ASHRAE
Chief Engineer
Hussmann Refrigerator Co.

Although it is obvious that the ambient will have a major effect on the refrigeration requirements of an open display refrigerator, little has been published showing the effect of various normal temperatures and humidities on this refrigeration requirement. Also, the refrigerated equipment has an appreciable effect on the food store air conditioning load. These subjects will be discussed in order to show the magnitude of this inter effect.

Symposium Abstracts Continued on Page 75

FORUMS

Forums offer highly informal discussions for the exchange of ideas. There are no prepared papers or talks, no notes or minutes are taken, it is all "off the record." Our guests of the press respect the spirit of the forum. Here is an excellent opportunity to exchange and discuss ideas and opinions.

Seven diversified subjects will be covered at the ASHRAE Vancouver Annual Meeting. These were selected on the basis of popular interest expressed from various sources. The forums to be presented, and their moderators, are as follows:

CRYOGENICS

V. J. JOHNSON
Member ASHRAE
Cryogenics Eng. Lab.
National Bureau
of Standards

ALUMINUM TUBE REFRIGERATION COILS

O. J. NUSSBAUM
Member ASHRAE
Kramer-
Trenton Co.

CORROSION WITH WINDOW AIR CONDITIONERS

C. O. HUTCHINSON
Member ASHRAE
Glidden Co.

REDUCING POWER NEEDS FOR HOT WATER SYSTEMS

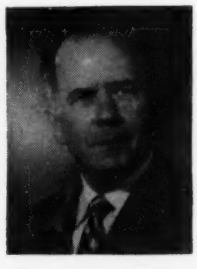
C. W. **POLLOCK**
Member ASHRAE
Crane Co.

PRACTICAL APPLICATIONS OF FOAM INSULATION

V. L. MILLER
Member ASHRAE
Pittsburgh
Corning Corp.

ECONOMICS OF ELECTRIC HEATING VS. FOSSIL FUELS

L. BOUILLON
Member ASHRAE
Bouillon, Griffith,
Christofferson &
Schairer



NOISE IN VENTILATING SYSTEMS—— J. B. GRAHAM, Member ASHRAE, Buffalo Forge Co.

They Wanted to Know

Inquiries of the month to ASHRAE Headquarters covered many points as to technical facts, standards, practices, personnel and published references. From these, the following have been selected and condensed as being those replies of some general interest and value to ASHRAE members.

COEFFICIENT OF HEAT TRANSFER

To ASHRAE:

What data do you have or know of that shows the coefficient of heat transfer "U" to be a straight line function? With regard to the correlation, if any, of heating in kwhr (electrically) a residence with weather conditions, what data do you have that shows this relationship separately, as affected by: Wind velocity, solar radiation, degree days, as well as the combined effect of all three, including humidity?

E. M. C.

We assume that you are interested in the U factor for building construction. Normally, this factor is related to a specific type of construction and equals the heat transfer through the construction measured in Btu per hr per line sq ft. (Fahrenheit degree difference in temperature between the air on the two sides). We suggest that you refer to Chapters 5 and 9 in the GUIDE which deal with Heat Transfer and Heat Transfer Coefficients of Building Materials. For further information on electric house heating, you might write to the Edison Electric Institute.

HIGH TEMPERATURE PSYCHROMETRIC CHART

To ASHRAE:

We could make good use of a high temperature psychrometric chart which would extend up to 212 F. Do you have any information relative to the availability of a special high temperature chart such as this?

W. D. J.

In our publication, Design Volume DATA BOOK, we have three psychrometric charts covering normal, low and high temperatures. The high temperature chart covers the dry bulb temperature range 60-250 F. Special high temperature charts may be obtained from the Industrial Research Service.

PLANNING A FUTURE

To ASHRAE:

I will be discharged from the service soon and am interested in obtaining information on the air conditioning and refrigeration fields. What are the requirements? Is advancement limited mainly to those who through college have become engineers or can a person such as myself with only a high school education find advancement through one of the trade schools? Can a person looking toward the future with an independent business in mind find it in this field or does his success lie in working with the large companies?

D. S. M.

An academic background is a definite help. In the design area, this is an absolute necessity. In most instances, design engineers in refrigeration and air conditioning complete the mechanical engineering course and then specialize in refrigeration. There are, however, two colleges that offer specialized courses resulting in Bachelor of Science degrees in refrigeration and air conditioning. For service and installation careers, it is recommended that the courses available at technical institutes or accredited vocational schools be completed. These courses give a good background in the theory of refrigeration and include a considerable amount of actual field work in installation and service. There is, of course, the opportunity of entering the sales or manufacturers' representative field. Such a step would require a certain amount of business education and experience before entering the field. There are also some excellent correspondence courses available.

AN ACCEPTABLE NOISE LEVEL

To ASHRAE:

We are working with a contractor and his design of an air-conditioning system for our synagogue and auditorium. We need information on the acceptable noise level we should tolerate. Some contractors have told us that with our present duct system there will be objectionable noise. Others have said there will not. The duct work is so installed that we cannot alter it in any way. Is there an acceptable decibel range or other form of measured values by which we could be governed?

B. J. E.

It is impossible to give a single decibel rating or range that could be based on any scientific measurement or standard. It is necessary to relate the noise level in each of the eight frequency bands. The subject is covered in detail in the ASHRAE GUIDE in the chapter on sound control. Noise criteria have been developed from studies and engineering experience for a number of acoustical spaces. Each criteria curve is a code for specifying permissible sound pressure levels in eight octave bands. For example, in the chapter on sound control the recommended noise criterion curve for churches is NC 30 and for assembly halls (amplification), NC 25-30. These curves have been weighted for reference and the decibel reading that would be closest to these criteria curves are, churches—40 DBA, and assembly halls—35-40 DBA. As it is impossible to give you a simple answer to your problem we suggest that you first refer to the material indicated above. Next check with a consultant who is experienced in this area.

TESTS FOR COEFFICIENT OF HEAT TRANSMISSION

To ASHRAE:

Has ASHRAE made any tests on the coefficient of heat transmission for walls constructed of lightweight aggregate masonry blocks with the voids or cores of these blocks filled with a vermiculite insulation?

K. A. H.

ASHRAE did conduct some tests on walls of this type of construction. Unfortunately, the blocks were not filled with vermiculite, but with cork, cinders, and other types of products. If you are interested in this, it may be found in the 1936 ASHVE TRANSACTIONS. The Vermiculite Institute does have an A. I. A. file No. 37-C-2 on this subject. You may address the Managing Director, Vermiculite Institute, 208 South La Salle St., Chicago 4, Ill.

ECONOMIZING FUEL

To ASHRAE:

If a house is equipped with storm doors and windows, is it any advantage to close draperies and lower window shades during the hours of darkness? The thermostat is at 73 F at all times.

E. G.

Principal heat loss in most houses is due to fenestration. If storm doors and windows are properly installed, the major heat loss is taken care of. It would be advantageous to close the draperies and lower window shades during the evening hours so that indoor heat is not conducted to the outside through the glass and crack areas. The degree of effectiveness of such draperies and window shades is, of course, related to the material. Such devices do reflect some of the heat back into the house and at the same time absorb a certain amount of the heat coming in contact. All such devices slow up the procedure of transmitting the heat to the glass or outer construction which would result in eventual heat loss.

There should be thermodynamic consistency in the construction and use of Psychrometric charts

JOHN A. GOFF

Just twenty years ago, under a cooperative agreement between the American Society of Heating and Ventilating Engineers and the Towne Scientific School, University of Pennsylvania, was begun an experimental investigation designed to close an essential gap in the then existing knowledge of the thermodynamic properties of moist air. The closing of this gap made possible the Goff-Gratch formulation soon adopted by the International Meteorological Organization in 1947 and by the International Joint Committee on Psychrometric Data in 1950 as being thermodynamically consistent with the best of existing data and in accord with the predictions of statistical mechanics.

The steam research program of the preceding two decades had pointed the way by its insistence upon thermodynamic consistency and accuracy as the only acceptable basis for international agreement, and what violence such insistence had to do to some strongly held notions appropriate only under the old caloric theory – mechanical equivalent of heat, heat units, heat content, heat of the liquid, total heat, etc. – was soon forgiven in the remarkable growth of interest in and understanding of thermodynamic theory encouraged by it.

Now facing the new American Society of Heating, Refrigerating and Air-Conditioning Engineers is a similar opportunity to encourage among its younger engineers a surer and more versatile understanding of thermodynamic theory in its application to the typical processes of heating, refrigerating and air-conditioning, by insisting upon thermodynamic consistency and accuracy in the graphical presentation of psychrometric data. It is the object of this paper to set forth some of the requirements of thermodynamic consistency in this connection.

Thermodynamic Theory – Of the basic thermodynamic properties with which the air-conditioning engineer has to work – volume v, absolute pressure p, empirical temperature t, and enthalpy h – all but one are intuitively obvious to him from his knowledge of mechanics and thermometry. He accepts absolute pressure p as normal force per unit area and pdv as the work of deformation in each infinitesimal step of a quasi-static (smooth) change of the simple substance under investigation. He may not be used to thinking of an adiabatic change as one that takes place inside an adiabatic container which, if rigid, would allow no changes occurring outside the container to produce any inside it; that is, he may not be used to thinking of adiabaticity as a feature of the container wall construction (thermos bottle!), the degree of which can, in any concrete case, be inferred from the indications of suitable instruments in a purely empirical manner and without any appeal to the notion of heat upon which the old caloric theory so firmly rested. But modern theory asks him to do this.

The First Axiom of thermodynamics asserts the existence, for any simple substance, of a function u(p,v), called the internal energy of the substance, such that, in any quasi-static adiabatic change of the substance, $du + pdv = 0$. This equation defines the one-parameter family of curves on the p,v-plane called the adiabats of the substance in question. For any substance there are infinitely many N,σ-planes on which these adiabats stand straight and vertical and on which $du + pdv$ is an element of area underneath the curve representing a quasi-static change. Presumably, for no actual substance is there an N,σ-plane on which isochors (lines of constant volume v) or isobars (lines of constant pressure p) are horizontal.

But the Second Axiom makes the bold assertion that every substance has an N,σ-plane on which its isotherms (lines of constant temperature t) are horizontal, the ordinate function being the same for all substances and with only one degree of arbitrariness, a multiplicative constant, called **absolute** temperature T(t); the corresponding abscissa function is called the entropy s of the substance in question. Thus, to volume v, absolute pressure p, and empirical tempera-

John A. Goff, Professor of Thermodynamics, School of Mechanical Engineering, University of Pennsylvania, participated in the Psychrometric Chart Symposium at the ASHRAE Dallas Semiannual Meeting, February 1-4 and spoke extemporaneously. He has prepared this material, based upon his remarks, at the request of the editors.

ture t, thermodynamic theory adds internal energy u, absolute temperature T, and entropy s, connecting them up with the identical relation, $Tds = du + pdv$. This then is the ultimate test of thermodynamic consistency among the thermodynamic properties of a simple substance.

Enthalpy – Consider a tank of volume V filled with air at pressure p and temperature T. From existing knowledge of the thermodynamic properties of air we know its specific volume v, its specific entropy s, and its specific internal energy u as functions of pressure p and temperature T. Therefore we readily compute the weight of air in the tank, $M = V/v$, the quantity of entropy in the tank, $S = Ms$, and the quantity of energy in the tank, $U = Mu$. Now let some air out of the tank. On the V,M-plane the statepoint moves horizontally to the left with ever increasing specific volume v which is the slope of the ray from the origin to the moving point. On the S,M-plane the statepoint heads straight for the origin along a ray of constant specific entropy s, if the tank is adiabatic and the changes occurring in it are quasi-static. But thermodynamic consistency requires that, at constant entropy ($ds = 0$), internal energy u must decrease as volume v increases, pressure p being positive. Therefore, on the U,M-plane the statepoint must take a path that is everywhere steeper than the ray from the origin with slope u.

It is easy to determine the slope of the U,M-curve described above. Since tank volume V is constant and tank contents homogeneous ($V = Mv$), it follows that $0 = Mdv + vdM$. Multiply this by the uniform pressure p and add the result to $dU = Mdu + udM$ to get $dU = (u + pv)dM$ by virtue of the fact that, as explained above, $du + pdv = 0$. Thus the slope of the U,M-curve exceeds that of the ray from the origin by amount pv. What is the physical interpretation to be put on this deduction?

It is clear that dU/dM is the decrease of tank energy per unit weight of air leaving. Since the tank is both rigid and adiabatic, the only way to account for this decrease is to suppose that dU/dM is energy convected out of the tank per unit weight of air so convected. We have to conclude, therefore, that the energy convected with a fluid is its enthalpy h, where $h = u + pv$ by definition. Thus is enthalpy added to the list of thermodynamic properties.

To illustrate, suppose that each of nine students in a certain class has exactly one dollar but would be required to take a dollar forty cents with him if he were to leave the room; then the result of a student's leaving the room would be to take a nickel from each of the eight remaining students. So with our adiabatic tank of air. Each pound of air leaving the tank has to take more energy with it (its enthalpy h) than it contributes to the total energy in the tank (its internal energy u) with the result that each pound remaining can contribute only less than it did before and must show its impoverishment by drop in temperature. This prediction is strikingly confirmed by experiment.

The search is for—

a surer and more versatile understanding of thermodynamic theory and its application

• • •

a new set of isobaric charts with mixing ratio and enthalpy as ordinate and abscissa, respectively

• • •

thermodynamic consistency

• • •

The problem is to steer a course between the poor intersections of wet-bulb and tables-enthalpy lines and the poor intersections of dry-bulb and chart-enthalpy lines

• • •

For the interests of thermodynamic consistency such things as sensible heat, latent heat, total heat, sensible heat factor ought to be precisely defined and re-named or dropped

So far heat has not even been defined and much less has enthalpy been connected with it. Heat is not a fundamental concept in modern thermodynamic theory, but it is customary to call the quantity, $du + pdv$, the differential heat absorbed in an infinitesimal step of a quasi-static change in order to be able to say that when the change is adiabatic no heat is absorbed. From the definition of enthalpy, $h = u + pv$, it follows that the quantity, $dh - vdp$, is also the differential heat absorbed. This latter says that when pressure is constant the increase of enthalpy becomes a measure of the quantity of heat absorbed, but the restriction to isobaric changes in a closed system is all too often forgotten and enthalpy wrongly regarded as just a highfalutin' name for heat content, total heat, or other misconception of the old caloric theory.

Basic Coordinates – The typical processes of heating, refrigerating and air-conditioning are, for the most part, steady-flow processes amenable to open-system analysis; and it usually suffices to make only weight and energy accountings, though sometimes an entropy accounting furnishes essential information also. The fluid, of course, is not a simple substance of fixed chemical composition requiring only two coordinates, but a binary mixture of dry air and water vapor requiring three. It is called moist air, and it has come to pass that both the engineer and the meteorologist are firmly committed to the use of weight of water vapor W, volume v, enthalpy h, and entropy s – all per unit weight of dry air – as basic thermodynamic properties in addition to pressure p and temperature T. This commitment has much to say about the choice of coordinates and parameters for both tabular and graphical presentation of psychrometric data. The weight of water vapor per unit weight of dry air W is called humidity mixing ratio, or just mixing ratio.

A typical air-conditioning process of particular importance in this discussion is the adiabatic (no heat involved!) mixing of two streams of moist air carrying, say m_1 and m_2 pounds of dry air per minute. Weight accountings for the dry air and water vapor are: $m_1 + m_2 = m$ and $m_1W_1 + m_2W_2 = mW$, respectively. The single energy accounting, assuming negligible kinetic energies, is: $m_1h_1 + m_2h_2 = mh$. Combined, the three separate accountings require: $W = W_1 + x(W_2 - W_1)$ and $h = h_1 + x(h_2 - h_1)$, where $x = m_2/(m_1 + m_2)$.

These show that mixing ratio W and enthalpy h of the resulting mixture vary linearly with the weight fraction x, and hence linearly with each other. To take advantage of this linearity in a thermodynamically consistent manner requires the use of mixing ratio W and enthalpy h – both per unit weight of dry air – as coordinates in graphical representation. It was R. Mollier who first (1923) called attention to this important requirement and showed how meeting it can greatly facilitate the understanding and graphical solution of other typical processes of air-conditioning and meteorology which are non-adiabatic (diabatic) and therefore do involve heat.

As previously noted, moist air is a binary mixture of variable chemical composition requiring no less than three coordinates, hence it is necessary to pick a third. For the air-conditioning engineer this would seem to be an easy task because, in most of the steady-flow processes he has to analyze, pressure p is very nearly the same at every section. Thus, a set of isobaric charts with mixing ratio W and enthalpy h as coordinates would seem admirably to meet his practical and sound educational needs. In a recent review of psychrometric charts, past and present, D. D. Wile rightly concludes that these must be the coordinates of the proposed new psychrometric chart.

Tables Enthalpy – From the identical relation written in the form, $Tds = dh - vdp$, we can read that with volume v, pressure p and temperature T all absolute, entropy s and enthalpy h are both relative, and with only one degree of arbitrariness, an additive constant. In the Goff-Gratch formulation giving the thermodynamic properties of moist air these constants have been disposed of by assigning both entropy and enthalpy the value zero at 0 F, 1 atm. in the case of dry air and at 32 F, saturated liquid in the case of water substance, in conformity with the usual steam tables practice. Enthalpies $\bar{h}_a$ and h_w that have the value zero at these reference points will be called tables enthalpies in what follows.

TABLE I: LINE ANGLES ON EXISTING CHARTS

	Mollier	Goff	ASHVE	Grubenmann	Isogonal	Carrier	Baker
ac/b (Btu/lbw)	468	1000	915	890	528	600	587
c (Btu/lbw)	1071	1000	1092	1074.96	564	1100	1107
Saturation Curve	48.4	60.9	66.7	65.2	29.8	57.2	57.1
Dry-Bulb Line	87.4	84.8	90.0	88.9	45	90.0	90.0
Chart Enthalpy, h	90	90	90.0	90	90	89.3	88.5
Wet-Bulb Line	155.7	136.2	136.3	139.5	135	150.6	150.9
Tables Enthalpy, $\bar{h}$.....	156.4	135	140.2	140.4	136.9	151.3	152.1

Chart Enthalpy – At zero pressure, according to the predictions of statistical mechanics, the enthalpy of a gas mixture is the sum of separate contributions from its constituent gases. This means that the tables enthalpy $\bar{h}$ of moist air per unit weight of dry air is subject to augmentation by a linear function of mixing ratio W, that is, by amount $c_a + c_w W$. Here c_a and c_w are any other constant values that could have been assigned to the specific enthalpies of dry air h_a and water h_w, respectively, at the reference points of the Goff-Gratch formulation, instead of the value zero actually assigned them in that formulation.

Now in constructing a psychrometric chart with enthalpy as abscissa, nothing is gained by making c_a different from zero because this would only amount to shifting the origin to the right or left along the dry-air axis ($W = 0$). But it turns out, as Mollier was the first to show, that much is to be gained by giving c_w a fairly large negative value $-c$ to turn the tables enthalpy lines, $\bar{h} = \text{const.}$, from the vertical counterclockwise through the angle arctan(c). This amounts to using chart enthalpy $h = \bar{h} - cW$ as abscissa instead of $\bar{h}$ itself.

Line Angles – The reciprocal slope of a line on the W,h-chart is $(b/ac)(d\bar{h}/dW - c)$, where a,b are scale constants appearing in the expressions, $y = acW$ and $x = b(\bar{h} - cW)$, for ordinate and abscissa, respectively, and $-c$ (Btu/lbw) is the value assigned to the specific enthalpy h_w of water at the steam tables reference point (saturated liquid at 32 F) for the purpose of chart construction. It follows that ac/b and c are convenient parameters in terms of which to compare existing charts as is done in Table I. The line angles listed in Table I are for 70 F on the saturation curve, but only the slope of the saturation curve changes much over any limited region of the chart.

Neither the Carrier nor the Baker chart, with temperature t instead of enthalpy h as abscissa, has an unique value of the constant c, but for each it is easy to compute a representative local value by means of which to compare the chart with others. The Isogonal chart is not an existing chart but only one here proposed for study as a point of departure for a more rational choice of the parameters, ac/b and c.

It is interesting to note that all the charts of Table I except the Isogonal have values of c close to the 1071 Btu/lbw used by Mollier to make the 32 F-isotherm stand vertical (horizontal on his h,W-chart) within the accuracy of his knowledge of the thermodynamic properties of moist air. Within the accuracy of the Goff-Gratch formulation, the isotherms of moist air are not straight (except at zero pressure) on the W,h-chart, so the reason for Goff's choice of an even 1000 Btu/lbw was to facilitate the calculation of cW by making it merely a matter of shifting the decimal point on W itself. The 1092 Btu/lbw attributed to the ASHVE chart has been inferred from the statement that its 70 F-isotherm stands exactly vertical, the statement being interpreted to mean that this isotherm's knee in the saturation curve is placed vertically above its foot in the dry-air axis. Grubenmann, still clinging, even in 1952, to the perfect gas laws with constant specific heats, followed Mollier in standing the 32 F-isotherm vertical. Perhaps the conclusion to be drawn from the small spread of c-values is that up till now "isotherms vertical" has been the fashion in psychrometric charts.

Intersections — On all charts of Table I the wet-bulb lines make poor intersections with the tables-enthalpy lines, which is probably the reason why one or other family of lines has been omitted from all but the ASHVE and Carrier charts and included in the latter only as lines of constant deviation from tables enthalpy $\bar{h}_s$ at saturation on the given wet-bulb line. On all but the Isogonal chart the dry-bulb lines make poor intersections with the chart-enthalpy lines, but it is not clear that this is the principal reason why the latter have been omitted from all but the Goff and Grubenmann charts.

The problem is to steer a course between the Scylla of poor intersections between wet-bulb and tables-enthalpy lines on the one hand and the Charybdis of poor intersections between dry-bulb and chart-enthalpy lines on the other. In the thermodynamic analysis of any physical process chart enthalpy can be substituted throughout for tables enthalpy without changing the physical meaning of the analysis, hence there would seem to be no more reason for complicating the chart with tables-enthalpy lines than the tables with values of chart enthalpy.

It must be admitted that the error caused by neglecting to take proper account of the energy convected in or out with liquid water added or removed is automatically kept small by the assignment zero at the tables reference point, saturated liquid at 32 F, in the case of the tables enthalpy; in other words it is safer, in some problems, to be thermodynamically inconsistent with tables enthalpies than with chart enthalpies. But it seldom pays in the long run to encourage inconsistencies of this kind because the practice often leads to systematic errors much larger than expected.

Even though the chart is to be written in a different key than the tables it is probably important to make transposition from one to the other as easy as possible. Perhaps the operation of reading both ordinate cW and abscissa h and adding them together to get $\bar{h}$ is not as easy as it sounds except when one of them happens to be a whole number. But here the poor intersections between wet-bulb and tables-enthalpy lines can be turned to advantage; for, by following the wet-bulb line to the nearest whole-numbered chart-enthalpy line (vertical grid line) and performing the addition there, almost exactly the same answer will be obtained. Thus, if cW can be read to $\pm e$ Btu/lbw then the ordinates can be spaced as far apart as $|(2b/a)(1 - c/\bar{h}'_w)e|$ without allowing an error greater than $\pm e$ in the determination of h by this procedure. Still it must be admitted that wide spacing of the ordinates tends to force transposition to tables enthalpy whereas this is strictly unnecessary.

Isotherms on the W,h-chart break at the saturation curve into straight lines running across the two-phase region with reciprocal slope dh/dW practically indistinguishable from that of the wet-bulb lines in the vapor-phase region, namely, $(b/ac)(\bar{h}'_w - c)$. If then the chart is provided with a built-in protractor reading $d\bar{h}/dW$, it will read $\bar{h}'_w$ as the reciprocal slope of the wet-bulb line intercepting the saturation curve at the given temperature. But here again graduation of the protractor to read $d\bar{h}/dW$ instead of dh/dW tends to favor the strictly unnecessary transposition to tables enthalpy.

Phase Coexistence Region—Only at zero pressure are the isotherms of moist air straight on the W,h-chart, but at this pressure there is no saturation curve nor any wet-bulb lines because only a single phase, the vapor phase, is physically realizable. And even though the isotherms are straight at zero pressure they are not equally spaced with respect to temperature, hence temperature cannot be substituted for enthalpy as abscissa without encouraging thermodynamic inconsistency in the use of the chart. This substitution is an important defect of the Carrier and Baker charts and, to the extent that it creates the misimpression that its abscissa is temperature instead of enthalpy, of the ASHVE chart also.

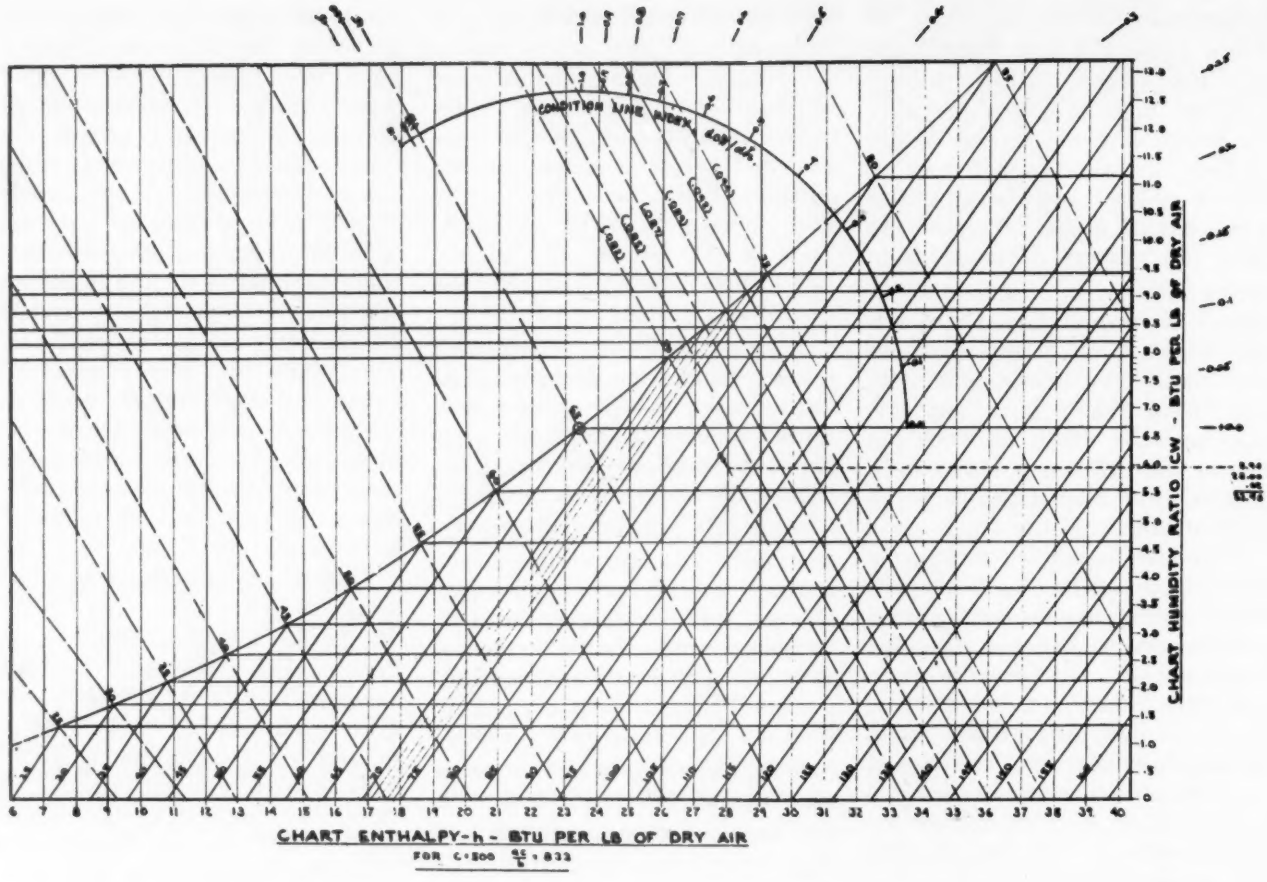
On the W,h-chart for a non-zero pressure there is a saturation curve that divides it into two regions, a vapor-phase region below and to the right of the curve, and a two-phase region above and to the left of it, the latter containing a small wedge-shaped three-phase region. The saturation curve swings upward to the right toward the $t_s(p)$-isotherm as asymptote, $t_s(p)$ being the saturation temperature of pure water at the given pressure p. In the vapor-phase region below the saturation curve the isotherms are nearly straight for any moderate pressure; in the two-phase region above the curve they are almost exactly straight even at fairly high pressures. Of course there are no isotherms for temperatures above $t_s(p)$ in the two-phase region because for such temperatures phase coexistence is physically unrealizable at the given pressure.

In the Carrier and Baker charts the two-phase region has been left completely undeveloped despite its great usefulness in the graphical solution of air-conditioning problems and its essential educational value. In the ASHVE chart this region has suffered considerable encroachment by legend and numbering for the tables-enthalpy lines.

Language—In the interest of thermodynamic consistency such notions as sensible heat, latent heat, total heat, sensible heat factor, etc., from the old caloric theory ought to be precisely defined and then re-named in a thermodynamically consistent manner, or dropped.

Relative Humidity — There has been much discussion during the past ten years of precisely what should be meant by relative humidity. The International Meteorological Organization tried in 1947 to answer the question by defining relative humidity as synonymous with degree of saturation. It did this out of consideration of the fact that, as Mollier had pointed out in 1929, degree of saturation is the obvious interpolant to use with thermodynamic properties referred to unit weight of dry air, for interpolating between their values on the dry-air axis and on the saturation curve at the given temperature and pressure.

But the definition evoked a storm of protest from those who, some with righteous indignation, contended (a) that relative humid-


CONDITION LINE INDEX, dcW/dh
CHART HUMIDITY RATIO cW - BTU PER LB OF DRY AIR
CHART ENTHALPY-h - BTU PER LB OF DRY AIR
FOR c=500 ac/b = 833

Sample Chart, above, is one of several skeleton cW,h-charts, each for different values of c and ac/b, being prepared to aid final selection. Each has been cropped on top, at 85 F on the saturation curve, on the right, at 85 F wet-bulb and 125 F dry-bulb, and on the left, at 25 F on the dry-air axis of abscissa. Each is for standard atmospheric pressure and for each, therefore, $ac/b = (42.921 - 0.01692c)/0.02642B$. The width-to-height ratio B has to be about 1.6 to make the chart fill an 11 x 17 sheet with only comfortable margins. The chart above is for c = 500 Btu/lbw and ac/b = 833 Btu/lbw. On it the 70 F dry-bulb, all the chart-enthalpy lines, and the 70 F wet-bulb are inclined to the dry-air axis at angles 54.6, 90, 123.3 deg, respectively. It comes near enough to being isogonal (45, 90, 135 deg) to enjoy the essential advantages of the latter disposition.

As noted above, the ordinate here is cW (Btu/lba) instead of W (lbw/lba) itself, but a round value, c = 500 Btu/lbw, has been chosen to facilitate conversion from one to the other by mental arithmetic. The uncommonly low value chosen offers some protection against cW's being called 'latent heat' with its unfortunate caloric theory connotations. If chart enthalpy turns out to be an acceptable name for the abscissa, perhaps chart humidity ratio (or chart mixing ratio) will be acceptable for the ordinate. The fact that the unit of cW is the Btu/lba should not be taken to mean that cW is some kind of heat because it has been over thirty years since the Btu was disconnected from heat by the First International Steam Tables Conference in 1929.

The horizontal grid lines shown are whole-numbered dew-point lines with non-uniform vertical spacing. Their use in chart construction expresses the view that their essential purpose is to guide the user easily and accurately in the horizontal direction to a closely graduated cW scale on either side of the chart there to do his interpolation, and that horizontal grid lines closely enough spaced for accurate on-the-spot interpolation would be somewhat harder to follow to the cW scale. Their use also tidies up the saturation curve by cutting down the number of intersections with each intersection shared by dry-bulb, wet-bulb and dew-point lines all having the same number.

Except, of course, that the chart-enthalpy lines have to have uniform horizontal spacing and hence their own private intersections with the saturation curve. But these vertical grid lines need not be at all closely spaced especially if it is decided to encourage (and thereby practically force) the user to work with tables enthalpy $\bar{h}$ rather than chart enthalpy h. For, to read tables enthalpy from the chart, all the user has to do is move parallel with the nearest wet-bulb to the nearest chart-enthalpy line, thence horizontally to either side of the chart there to read cW; the addition, h + cW, he can easily do by mental arithmetic. The result is extremely close to the correct answer for the tables enthalpy $\bar{h}$ at the given point, but not quite, because the wet-bulb line traveled to the nearest chart-enthalpy line diverges appreciably from the tables-enthalpy line that he should have traveled but couldn't because it is not shown on the chart. The divergence is proportional to the horizontal travel, the proportionality constant being $h_w/(c - h_w)$, the value of which is given in parentheses on the wet-bulb line to which it belongs. To illustrate: from 85 F and 70 F to the nearest chart enthalpy of 28 Btu/lba the horizontal travel is about + 1/4 Btu/lba and the divergence, therefore, is about 0.082/4 = +0.02 Btu/lba. Here the chart humidity ratio cW is 5.94 Btu/lba, hence the tables enthalpy at the given point is 28 + 5.94 + 0.02 = 33.96 Btu/lba.

To facilitate finding the condition line of a given cooling load problem, for example, the chart should be provided with a protractor reading $d\bar{h}/dcW$ or its reciprocal $dcW/d\bar{h}$, if it is decided to encourage (and thereby practically force) the user to work with tables enthalpy instead of chart enthalpy. In this chart the protractor is centered at 65 F on the saturation curve and graduated to read $dcW/d\bar{h}$ directly. For this important quantity the name condition line index is here proposed. Its reciprocal, for c near 1100 Btu/lbw, has been called (see the 1959 ASHRAE GUIDE, p. 199) enthalpy-humidity difference ratio, which is meaningful if somewhat long, alternatively, heat-moisture ratio and sensible heat factor both of which are thermodynamically objectionable. It seems that $1 - dcW/d\bar{h}$, with c about 1100 Btu/lbw, is a thermodynamically consistent formulation of what is called sensible heat factor on the Carrier chart. In the interest of thermodynamic consistency these notions of sensible heat, latent heat, total heat, sensible heat factor, etc., from the old caloric theory, have to be defined and re-named or discarded.

ity as the ratio of vapor pressures is altogether too firmly established in hygrometric formulae of the type usually attributed to Regnault (1845) to warrant its expropriation for some essentially different magnitude; (b) that relative humidity as the ratio of vapor pressures is so extensively used in the presentation of meteorological data, properties of hygroscopic materials, drying-rate data, etc., that its connection with vapor pressures must be preserved; (c) that relative humidity as the ratio of vapor pressures, or of vapor densities though the two are different, is a fundamental concept whereas degree of saturation as the ratio of mixing ratios is essentially an artifice; (d) that relative humidity as the ratio of vapor pressures has real physical significance at temperatures above the saturation temperature of pure water for the given pressure whereas the ratio of mixing ratios must go undefined there.

Without conceding merit to the last two contentions, the World Meteorological Organization did in 1953 rescind the 1947 recommendation of the International Meteorological Organization, and did adopt in its place the recommendation that relative humidity be defined as the ratio of the given vapor partial pressure (vapor mol-fraction times pressure) to the vapor partial pressure at saturation at the given temperature and the given pressure.

As thus re-defined, relative humidity (a) is exactly zero for dry air and exactly unity (100%) everywhere at saturation and therefore expresses relative proximity to saturation at the given temperature and pressure and (b) is completely undefined at temperatures and pressures where saturation is physically unrealizable. Saturation had previously been defined as the condition for phase coexistence in neutral equilibrium across a flat surface of separation, with the understanding that each coexisting phase is said to be saturated with respect to the other and that it is the phase that is saturated, not the space occupied by it.

Now the substitution of $p_s(t)$, the saturation pressure of pure water at the given temperature, for $x_s p$, the vapor partial pressure of moist air at saturation at the given temperature and pressure, causes only a small error in the calculation of relative humidity, provided that saturation is physically realizable at the given temperature and pressure. There the substitution is of the nature of an approximation, and approximations clearly recognizable as such are often indispensable in engineering analysis. But when the substitution is continued outside the rather small region of the p,t-plane between the critical isobar and the saturation curve of pure water, then it ceases to be an approximation to anything physically realizable and becomes a source of much confusion to the practicing engineer who wants to cling to the idea that relative humidity is relative proximity to saturation.

If Wile is right in concluding that common usage demands the inclusion of relative humidity lines on the new chart, then perhaps they must be included at whatever cost in simplicity, readability and consonance with the use of mixing ratio and enthalpy per unit weight of dry air as coordinates.

Recommendations—The above discussion leads to a few specific recommendations as follow:

(a) The new chart should be a set of isobaric charts with mixing ratio W and enthalpy h as ordinate and abscissa, respectively, the chart parameters c and ac/b to be chosen in a more rational manner than heretofore and the choice to be clearly and prominently stated on the chart to obviate misimpressions.

(b) The wisdom of showing relative humidity lines on the chart should be reviewed keeping in mind that relative humidity is not the best interpolant for use with thermodynamic properties referred to unit weight of dry air and that degree of saturation is the interpolant used with the tables of which the chart is to be a faithful representation.

(c) Names of ill-defined and thermodynamically inconsistent quantities should be omitted from the chart. A carefully written text scrupulously observing the requirements of thermodynamic consistency should explain the construction and intended use of the chart.

(d) One of the set of isobaric charts should be for standard atmospheric pressure. It should probably be subdivided into a low-temperature chart, an ordinary-temperature chart, and a high-temperature chart. Tentative recommendations as to the manner of subdivision should be formulated soon.

(e) Tentative recommendations as to pressure levels for other isobaric charts of the set should be formulated soon also.

COMMERCIAL REFRIGERATION SYMPOSIUM — CONTINUED FROM PAGE 68

Condensation in and on open display equipment as related to air-conditioned vs non air-conditioned stores

J. A. BIGGERS

Associate ASHRAE

Director of Engineering
Friedrich Refrigerators Inc.

This topic will be covered in an informal presentation which will include slides and graphs to illustrate the subject under discussion.

The type of store air conditioning will be limited to mechanical direct expansion type. A brief outline of the subjects to be discussed follows.

Conditions at which condensation occurs in air-conditioned and non air-conditioned stores as related to refrigerated open display equipment.

Methods of correcting conditions at which condensation occurs in air-conditioned and non air-conditioned stores as related to refrigerated open display equipment.

Areas where condensation occurs in refrigerated open type display equipment and its effects on the case, product and consumer.

Methods of correcting condensation areas in and on refrigerated open type display equipment.

ASHRAE Standard 30-60 adopted at Dallas

A. T. BOGGS, III
ASHRAE Technical Secretary

At the Semiannual Meeting in Dallas, Standard 30P **Methods of Testing for Rating Liquid Chilling Packages** was adopted. This standard is now designated as Standard 30-60 with an effective date of February 1, 1960. Copies are available through our Sales Department.

Two revisions to existing standards will be available in the near future. Standard 22-48R on **Water-cooled Condensers** has been submitted to the Board of Directors for approval to publish in the JOURNAL. This will give readers an opportunity to review the standard and submit comments to the Technical Secretary.

Standard 47-35R has also been revised and approved by the project committee and Standards Committee and is presently being considered by the Board of Directors for approval to publish in the JOURNAL. This Standard covers **Testing and Rating Return-Line Low-Vacuum Heating Pumps.** Both standards should be available for membership following the 67th Annual Meeting in Vancouver.

ASA—For the benefit of those who who have need to contact the American Standards Association, its new address is 10 East 40th Street, New York 16, N. Y.

CMC Spring Meeting – The **ASA Company Member Conference** will hold its Spring Meeting at the Sheraton Hotel in Philadelphia, May 2-3. This conference, which will be concerned mainly with standards problems of individual companies, is open to non-members as well as members of ASA. Information may be obtained by writing H. G. Lamb, Secretary, Company Member Conference, ASA.

Y10.14-1959 – The new American Standard **Letter Symbols for Rocket Propulsion** is available from ASME, sponsor, at $2 per copy. There are presently 12 letter symbols standards available that have been developed by Sectional Committee Y10. A complete list is available from ASA or ASME.

Z21.30-1959 – The installation of gas appliances and piping is now covered in a single American Standard. The revision to Z21.30-1954 has been approved by ASA as American Standard **Installation of Gas Appliances and Gas Piping.** This standard includes all fuel gases. It is published by AGA and is available from ASA, Dept. PR122 at 50c per copy. Sectional Committee Z21 has developed 40 American Standards intended to protect the public by insuring safe and satisfactory utilization of gas.

Z21.40-1959 – A new American Standard covering gas-fired summer air conditioners has been approved by ASA and published by the American Gas Association. American Standard **Approval Requirements for Gas-Fired Air Conditioning Appliances** is available at $2 per copy from ASA, Dept. PR 113.

Z65.4-1959 – Nationally approved methods for measuring the area of hospitals and related facilities are now available in American Standard **Methods of Determining Area in Hospitals and Related Facilities.** This standard includes methods of determining gross area, circulation areas for patients and visitors, and departmental areas. Copies are available at 50c each from ASA, Dept. PR 129.

1960 Price List and Index of American Standards is available free from ASA. This publication lists more than 1800 American Standards approved to date.

Nema—The 1960 GUIDE to NEMA STANDARDS PUBLICATIONS is available free on request from Nema, 155 East 44th Street, N. Y 17, N. Y.

USAF – The Air Force has announced a newly-established requirement for ARI certification for all unitary air conditioning equipment. Provisions for the new certification requirement are spelled out in **Air Force Pamphlet 91-2-1** dated January 29, 1960. At the 1959 Air Conditioning and Refrigeration Conference, Major General Minton, Director of Civil Engineering, stated: "I plan within a reasonable period of time, after we are certain the certification program is adequate, that the Air Force will require, in our invitations for bid, ARI certification before we will accept the equipment." It was also requested by General Minton that industry enlarge the certification program to include larger units, the heat pump, and related equipment.

ARI – Recently published ARI Standard 515-60 replaces Standard 320-56 which will be withdrawn

from circulation. The new standard, **Sealed Refrigerant Compressors and Condensing Units, 20 Horsepower and Smaller,** establishes for sealed refrigerant compressors and condensing units required specifications of what constitutes standard equipment; recommended minimum net volumes of liquid receivers; recommended minimum tube-connection sizes for liquid-line and suction-line shutoff valves; recommended requirements for testing and rating including Standard Rating Conditions; recommended minimum performance requirements; provisions for safety; and recommended installation and service instructions. The standard applies to units using Refrigerants 12 and 22. Copies of the new standard are available from ARI at 25c per copy.

ASTM – Now available is the second edition of **ASTM Standards on Metallic Coated Iron and Steel Products, A-5.** This second edition is a complete revision of the 1956 first edition. Of the 34 standards, all but 5 have been newly added, revised, or have had their status changed. The publication includes 25 specifications, 6 methods of test, and 3 recommended practices. Engineers and scientists concerned with coated metallic products, corrosion and maintenance, should find this compilation useful. Copies are available at $3.50 each from ASTM headquarters, 1916 Race Street, Philadelphia 3, Pa.

SPI—A proposed commercial standard on polyethylene pipe has been approved by the **Thermoplastic Pipe Division of the SPI.** The document covers three types of polyethylene pipe: Type I (0.910 to 0.925 specific gravity – CM^3); Type II (0.926 to 0.940 specific gravity – CM^3); and Type III (0.941 to 0.965 specific gravity – CM^3). The proposed standard covers Schedule 40 and Series 2 and Series 3 polyethylene pipe.

US DEPT OF COMMERCE: A Standard CS 195-57, designated proposed revision to Commercial TS54-53, Warm-Air Furnaces Equipped with Pressure-Atomizing or Rotary-Type Oil Burners, July 22, 1959 has been distributed to industry for comment. The recommended revision includes the composite views of organizations represented on the standing committee including UL, FHA, and manufacturers and distributors of warm air furnaces. When TS-5453 has been accepted by a representative cross section of the industry, printed copies of the new edition will be made available.

UEC ahead on work schedule

Preliminaries, such as excavations for footings, plumbing and concrete work are virtually completed for the new multi-Society United Engineering Center in New York. Steel erection is scheduled to start early this month.

In fund raising, the American Institute of Consulting Engineers has joined with the American Institute of Chemical Engineers in exceeding 100% of their quotas.

Our ASHRAE remains among the laggards. The official score to date shows $19,707 from 470 contributors. We started with a $250,000 goal.

It has been announced that plans for future expansion within the design of the 18-floor UEC would add as much as 8,500 sq ft from the 3rd to 8th floors and 6,000 sq ft from the 9th to the 12th.

Zoned control air conditioning will operate throughout the building. There will be a 225,000 volume reference library.

New trends in

Warm air heating

and air conditioning systems

H. T. GILKEY
Member ASHRAE

The heating and air conditioning industry is on the verge of major break-throughs which will result in totally new designs using new materials and techniques. Some of these things are already on the market, but it may be some time before all of their characteristics can be used to best advantage.

It is yet difficult to predict all of the ramifications of some of these developments, but some possibilities are obvious. For example, the furnace heat exchanger can be made a great deal smaller as a result of some of these new developments. A direct-fired heat exchanger of about the same size and configuration as the cooling coil on an air conditioning unit no longer stretches the imagination.

Work has been done recently on developing methods of catalytic combustion using gaseous fuels. One device of this type consists of a porous ceramic tube into which a gas-air mixture is fed under pressure. After the fuel air mixture has been ignited on the outside of the tube and the tube itself has come up to temperature, essentially flameless combustion is maintained.

The tube itself is incandescent and there is a surface plasma which has a temperature of around 1800 or 2000 F. The tube is constructed of a special ceramic material, for its walls are from ⅛ to ¼ in., while the temperature gradients across them may be in excess of 2000 F.

It has been estimated that the dimensions of a furnace of this sort could be about half the size of a gas-fired furnace, assuming equal outputs. Efficiency could be increased somewhat, possibly 10 or 15 percent. Additionally, using an induced-draft fan, and because of the higher efficiency and resulting lower exhaust temperature, could reduce materially the chimney requirements, both in size and in complexity.

Catalytic combustion units have been built and are in use, though not in central heating equipment as we know it. Furthermore, the principle of induced-draft venting is commonly used in large commercial installations.

During the last year, there has been put on the residential market an oil-fired furnace which utilizes this principle. Hence, it is only necessary to combine these two features, catalytic combustion and induced-draft venting, in order to make this futuristic concept a reality.

Another approach to this general principle would be thermionic conversion. Application of this phenomenon is probably further in the future than is catalytic combustion. In its simplest form, a thermionic converter involves a heated plate and a cooled plate. Its operation is based upon the fact that electrons are emitted from metals at high temperatures. In a thermionic converter, electrons are emitted more rapidly from the heated plate than from the cool one, so that there is a net flow of electrons from the heated plate to the cool plate. This phenomenon, first discovered by Thomas A. Edison, is known as the "Edison Effect."

This net flow of electrons from one plate to another is an electric current. These two plates can be connected with an external circuit, and make the electric current do some work. What results is a device which converts heat energy directly into electrical energy. Here it is presented in an over-simplified manner, for there are many problems to be overcome in developing practicable thermionic converters for use.

In the case of summer air conditioning, it is possible to achieve humidity control by using one of several devices. Two-compressor systems have been used to do a partial job. Another practical approach is the reheat system.

Here is how the reheat cycle is applied for humidity control. Humid warm air enters the cooling coil. As it passes through the coil, moisture is removed from the air, and the air is cooled. In order to prevent the house from getting too cold, however, the air then passes through a reheat coil. In this reheat coil sensible heat is added, the air is warmed but it is not rehumidified.

Advances in system component design have also been made. Simpler and relatively inexpensive electrostatic air cleaners are now available. These air cleaning devices cost more than conventional types of filters, but they also do a more complete air cleaning job.

Control components and systems have also changed greatly during the last few years. Not only have controls been restyled for more pleasing appearance and redesigned for improved precision, but also entirely new concepts of control have been introduced.

Humidifiers are another system component which have changed during the last few years. As was the case with both air cleaning devices and control systems, humidifiers of various degrees of effectiveness are now available. These in-

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H. T. Gilkey is Director of Technical Services, National Warm Air Heating and Air Conditioning Association. This is a condensation of a paper presented by author Gilkey at the 17th Annual Convention of the National Warm Air Heating and Air Conditioning Association of Canada, March 15, 1960.

clude electric humidifiers which may be installed in the plenum of the furnace. Another type atomizes the water and injects it into the supply air stream in a spray of invisibly small droplets.

In some cases, these humidifiers which provide for the positive addition of moisture are so effective that control by means of a humidity controller is desirable. Humidity is necessary for comfort, but too much moisture can cause structural damage to any building.

The use of new materials for ducts is becoming increasingly common. These include insulating materials, plastics, and fibers, as well as new metallic products.

Other materials are designed for use where flexibility is desirable, and this makes installation easier under certain circumstances.

Supply outlets have not yet been mentioned, but here, too, there have been advances. There is an increasing consciousness by diffuser manufacturers of two things, performance requirements for supply outlets and the appearance of their products. Performance has resulted in more complete information on the pressure loss, throw, and spread characteristics being available. Additionally, better guidance is being given to the installer on the application of specific types of outlets.

Modern diffusers are designed to do a specific air distribution job. Unfortunately, the designs required to do this are such that measuring the diffuser free area becomes extremely difficult. Strangely enough, the free area, or effective area as it will probably be called, can be more easily determined by test than by measurement. Right now, several manufacturers are in the process of verifying this test method on several types of diffusers.

OHI Diamond Jubilee

Celebrating a much-heralded Diamond Jubilee, with somewhat less confidence than caution, the Oil-Heat Institute met in New York, April 3-7, for its 38th Annual Convention. Linked with it was the 23rd National Oil Heat and Air Conditioning Exposition.

Primarily a distribution division program, with concentration upon the many aspects of business-building rallies, the meeting included but a single technical division session. This was a three-speaker symposium on April 5.

Wistfully reminiscent of what appears to have become an industry inferiority complex, the feature speaker was programmed for "We Don't Have to Be Satisfied with Leftovers." Vice President John Olson, in charge of Sales for Nu-Way Corporation, drew a grim picture of once-dominant oil as a heating medium, hard-pressed by gas, electricity and miscellaneous newcomers. It was his forthright concession that oil was getting just the leftovers when the others had had their pick.

Indeed, this set the pace for the other discussions at this technical session.

Speaker Olson called for improved methods of installation, backed by service schools, an indicative shield for approved jobs and certification of service men. He explored free service at a cost to be covered by an incremental increase in the cost per gallon to the consumer. He reviewed progress in new forms of oil burning equipment and cited the need for lower capacity burners to better serve the domestic hot water heating field, the desirability of reducing physical size of installations generally, of narrowing the cost differential between gas and oil burners, of reducing complexity and of minimizing the array of present day accessory features and controls. He also suggested possible gains in thermal efficiency by the recirculation of the combustion product. That a large home building group found burners over-capacitied for 75 per cent of its planned construction was given as one reason for gains by competitive gas.

Last, but assuredly not least, he urged consideration of a new trade association which would bring all elements of the oil heat business to a coordinated functioning that would eliminate cooperative gaps and promote industry thinking and functioning toward a common goal.

WHAT ABOUT FUELS?

Authoritatively challenging the concept that oil company refinery research might have been laggard, Russell Henry of the Shell Oil Company portrayed graphically the basic changes in volume demands for petroleum processes and linked them with improved, more costly refinery equipment and methods that assured an overall balance of supply and fuel characteristics. It was conceded that some newer refining methods had introduced complexities which made fuels of the same "standard" designation something less than compatible as between refiners and geographical areas.

BETTER EFFICIENCIES

Reporting more fully upon a project initiated some time ago by Esso Standard, H. L. Baker reviewed the concepts, development, sales, effectiveness and acceptance of a plan which brought assured economies and satisfaction to an original "guinea pig" group of oil burner owners and upon which a far broader program has been based subsequently.

It was the objective here to improve overall efficiency of certain applicable installations by resizing nozzles, better controlling stack CO_2 and temperatures, by the use of combustion zone baffles and similar expedients.

A major feature of the program was the Annual Convention Luncheon where Al Loucks, President of the OHI of Oregon was toastmaster and Friedrich von Saurma, Chief Rocket System Information Office, Red Stone Army Missile Base and Project, was the guest speaker.

Meetings ahead

May 1-3 – North American Heating and Air Conditioning Wholesalers, Spring Convention, New Orleans, La.

May 19-21 – Refrigeration Research Foundation, Annual Meeting, Denver, Colo.

May 22-25–Industrial Heating Equipment Association, Hot Springs, Va.

May 23-26–American Society of Mechanical Engineers, Design Engineering Conference, New York, N. Y.

May 23-26–Design Engineering Show, New York, N. Y.

June 6-9 – Institute of Boiler and Radiator Manufacturers, Annual Meeting, Absecon, N. J.

June 6-9 – National District Heating Association, 51st Annual Meeting, Asheville, N. C.

June 6-10 – Institute of Appliance Manufacturers, Cincinnati, Ohio.

June 13-15–American Society of Heating, Refrigerating and Air-Conditioning Engineers, 67th Annual Meeting, Vancouver, B. C.

June 15-17–1960 Heat Transfer and Fluid Mechanics Institute, Stanford University, Stanford, Calif.

August 23-25–Sixth Cryogenics Engineering Conference, Boulder, Col.

October 10-12 – American Gas Association, Annual Convention, Atlantic City, N. J.

October 28-November 2–Air Conditioning and Refrigeration Wholesalers, Silver Anniversary Convention. SS Hanseatic.

October 31-November 3–Institute of Boiler and Radiator Manufacturers, Semiannual Meeting, Absecon, N. J.

November 14-17–National Warm Air Heating and Air Conditioning Association, 47th Annual Meeting, Cleveland, Ohio.

November 18-22 – Air Conditioning and Refrigeration Institute, Annual Meeting, Hollywood Beach, Fla.

People

C. Milton Wilson, in his new post as General Sales Manager of Recold Corporation's Air Conditioning Div, will coordinate and direct sales of air conditioning products. Formerly General Sales Manager of Anemostat Corporation of America, he is one of the pioneers of high-velocity air distribution systems and is the author of many technical articles on this subject. A member of the Public Relations and Advertising Committees of ASHRAE, he is on the Executive Committee of the New York Chapter.

Orion O. Oaks died on March 16th at the age of 75. A Life Member, he was a past-President of the New York Chapter of the former ASHAE. Owner of his own consulting engineering firm, Orion O. Oaks Associates, and a former Chief Engineer of American Radiator Company, he held 25 patents concerned with liquid heat and worked during World War II on the development of liquid heat and synthetic rubber.

William T. Smith has been promoted to Chief, Utilities Engineering Sect, Directorate of Civil Engineering at the Pentagon, Washington, D. C.

Lincoln Bouillon is President of newly incorporated Bouillon, Griffith, Christofferson & Schairer in Seattle. This organization succeeds several precedent partnerships dating back to 1941. **H. T. Griffith** is Vice President and **L. F. Christofferson** is Treasurer.

Harold F. Farquhar becomes Chief Engineer of Lau Blower Company, leaving his position as Assistant Chief Engineer in Charge of Services. For 12 years Chief Engineer and Secretary of Farquhar Company, he joined Lau this past year. He was graduated in 1941 from Carnegie Institute of Technology with a B.S. degree in Management Engineering.

Samuel Shawhan, continuing in his position as President of Bryant Manufacturing Company, a div of Carrier Corporation, has been elected Vice President of the latter organization. A graduate of the University of Kentucky, he joined the company in 1929 as a research engineer. He was Assistant to the President before being assigned to head Bryant operations in 1958.

P. R. Achenbach, currently serving ASHRAE as a member of the General and Administrative Coordinating Committee, Vice Chairman of the Admissions and Advancement Committee and consultant to the Research and Technical Committee, has been designated a "Fellow of the Society," receiving this honor at the Dallas meeting. Active in both societies since his election to ASHAE in 1942 and to ASRE in 1947, he is a past-President of the Washington Chapter, ASHAE, and past-Chairman of the Baltimore-Washington Sect, ASRE. His participation in ASHAE affairs includes: Secretary, Chapters Conference Committee, 1950; Nominating Committee, 1951; Guide Committee, 1952-55; and Committee on Research, 1958, as well as service on numerous Technical Advisory Committees. In ASRE he was a member of the Education Committee, 1957-58; Standards Committee, 1955-57; Chairman, TC 4.4, 1955-56; Ps-12 Committee, 1957-59, and TC 1-8, 1957-59. Author of several articles in Refrigerating Engineering and Heating, Piping and Air Conditioning, he was Chapter author and Associate Editor of the 8th, 9th and 10th Design Volume of the ASRE Data Book and worked on revisions of the ASHAE Guide.

R. D. Rupprecht has been elected a Vice President of Armstrong Contracting and Supply Corporation at the organization's annual meeting. Joining the company in 1940 after his graduation from Pennsylvania State University, he was a Building Materials Div salesman until 1954, when he was appointed Assistant District Manager of the Div's Baltimore office. He became District Manager of the Insulation Div in 1956. He will continue in this position in addition to his new responsibilities as Vice President.

John J. Seelaus has joined Air Conditioning Associates, Inc. as Sales Manager for heating, refrigerating and air conditioning. Previously, he had been associated with York Corporation's Philadelphia sales office for more than ten years, in the position of District Engineer. Past-President of the Philadelphia Chapter of the former ASRE, he received the Wolverine Award in 1953.

Robert G. Strong, Manager of the West Coast Plant of Keco Industries since 1957, has been elected Vice President of the company.

Lee Nusbaum, 80, President of Pennsylvania Engineering Company in Philadelphia, died recently. Founder of the business in 1905, he was a pioneer in air conditioning and refrigeration, and was a Life Member of ASHRAE.

William H. Wentling, formerly Chief Engineer of Lau Blower Company, advances to the new position of Director of Engineer, and will be in charge of all engineering operations. Associated with Lau for the past 12 years, he has been Chief Engineer since 1954. Prior to joining the company, his experience covered design of aircraft components, industrial fan equipment and heating and air conditioning equipment. He has been granted several patents in the air conditioning and air moving fields.

Richard J. Peterson, recently appointed Chief Engineer in Charge of Research and Advanced Development Engineering for Utility Appliance Corporation, has been with the company since 1939. Now responsible for development of new products relating to the current line of the Gaffers & Sattler Div, he will continue to supervise engineering programs for blowers and evaporative coolers.

Saul Saulson, Vice President of Albert Kahn Associated Architects and Engineers, has relinquished the duties of Chief Mechanical Engineer, which he has discharged for more than 40 years, in order to devote his efforts to his position of Director of Mechanical Engineering. He will be responsible for advance analysis of all projects with respect to mechanical requirements and projected suitable mechanical engineering designs.

Graeme B. Supple, promoted to a position in charge of future planning and development for products connected with the air side of air conditioning product lines for American-Standard's Industrial Div, will have the title Product Manager. His office will be in Detroit.

Don M. Robinson, moving from Houston to Baltimore, and **John B. Freeman,** from Detroit to Houston, are ASHRAE members assuming new positions with Buffalo Forge Company. Robinson has represented the company since 1927 in the pump div, engineering dept and in various cities, including Houston, where he has been Sales Representative for the past 15 years. Freeman, who has had training at the Buffalo plant in addition to field experience, has served in the Detroit area for nine years.

Others are saying——

that . . . . . existing methods of heat pump hermetic motor protection include: thermal industrial overload relay, thermal quick-trip overload relay, magnetic overload relay, current biased thermostat, discharge gas thermostat and embedded thermostat. Discussed in this article is the effect of each of these devices and an evaluation of its limitations. *Air Conditioning, Heating and Ventilating, February 1960, p 74.*

that . . . . . hot water systems heated by electricity in off-peak periods have been found, in the majority of cases, to be competitive with direct electric off-peak systems. It is the contention of the author that electric heating will not supersede the use of solid or liquid fuels in the near future, the latter continuing to carry the bulk of building heating load. *Journal of the Institution of Heating and Ventilating Engineers, March 1960, p 337 (British).*

that . . . . . inert gas shielded arc welding operations often lend themselves to a total enclosure or glove-box design from fume control and ventilation. This type of unit, with the worker located outside the box and an access door provided for routine maintenance, also serves as an excellent way of ventilating automatic buffing operations. Existing installations are described in this article, which also covers ventilation of brass melting furnaces, where lead and zinc fumes, high temperature waste air and greasy oil smoke are major problems. *Air Engineering, February 1960, p 32.*

that . . . . . any analysis of electric heating should be based on: electric heating systems available, including resistance and nonresistance types; construction requirements; and a complete heat balance study as a basis for determining first and operating costs. This method should not be used where electric rates are prohibitive, service is not dependable or for uninsulated structures with high heat loss per sq ft and little or no internal gain. *Consulting Engineer, February 1960, p 102.*

What ASHRAE Regions and Chapters are doing

Nominating Committees of several Chapters presented proposed slates of officers for the 1960-61 season. Noted among technical sessions held were seminars on Peltier refrigerating machines and cooling loads.

TOLEDO . . . Principal among factors influential in education of children is thermal environment, stated Zeph Marsh, School Market Sales Manager, Minneapolis-Honeywell Regulator Company, in a talk given at the March 7th meeting. Speaking on "The Engineer's Responsibility in Air Conditioning of Schools," he urged departure from "architectural gingerbread" and established design procedure to permit attainment of the real goal, better education.

NORTH PIEDMONT . . . At the March meeting, Donald E. Kvalnes of E. I. du Pont de Nemours & Company spoke on raw materials, manufacturing processes, end products and applications of halogenated hydrocarbon refrigerants. Technical information on the refrigerants was presented.

MONTREAL . . . Application of starters and control centers on motors normally associated with air conditioning equipment was covered at the March meeting by Harold Buchanan of Canada Westinghouse Company, Ltd. Art Reed of the same company continued this discussion with a talk on the motors themselves, their windings, insulation and construction for quiet operation. Slides, diagrams and a sample of modern insulating materials as used in motors illustrated the speakers' remarks.

EVANSVILLE . . . Elected to the Nominating Committee at the March 1st meeting were past Chapter Presidents R. P. Garvey and J. F. Dewey, Albert K. Miegl of Arkla Air Conditioning Corporation, Harold Tillman of Whirlpool Corporation and John Downen of Bendix-Westinghouse. This committee will present a slate of officers for 1960-61 at the April meeting.

Speaker of the evening was Dr. Carl Ashby, President of Conrad, Inc., who utilized charts and pictures to illustrate engineering problems and necessary equipment and systems in the building of specialized environmental chambers. Charts showed characteristics of environments at varying altitudes to 2,000,000 ft; environmental chambers attempt to approach conditions existing at these various altitudes. Variable factors considered include temperature, humidity, pressure, sand and dust, rain, vibration, acceleration, radiation, high air velocity and combinations of these. Conrad builds equipment simulating the first five of these conditions.

Dr. Ashby showed a chart of a cascade refrigeration system, using Refrigerants 13 and 22, for temperatures down to −150 F. With a Refrigerant 14 auxiliary system, a temperature of −200 F can be attained. Problems encountered when reducing temperature from 500 or 1000 to −100 F or lower were explained. Also discussed were a humidity system diagram for use in humidity control chambers, a schematic vacuum system for an altitude chamber simulating conditions to 400,000 ft and a vacuum system for up to 1,000,000 ft.

Concluding his address, speaker Ashby showed members and guests photographs of actual environmental chambers.

WISCONSIN . . . 3600 rpm pumps and problems of noise were discussed by Paul Hooper of Worthington Corporation, speaking at the March 21st meeting. Mentioning the fact that these pumps are used for higher head systems, he outlined causes of noise such as coupling misalignment, velocity, bearings and improper seating of baseplate. Use of a pump as visual aid illustrated these causes of noise, but the speaker concluded by stating that in most cases noise is a problem of the system and not the pump.

PITTSBURGH . . . Nominating Committee slate of officers for the 1960-61 season includes: C. W. Stanger, President; George Smetak, 1st Vice President; Anthony Estatico, 2nd Vice President; Harold Shratter, Secretary-Treasurer; Dean Hicks, Assistant Secretary-Treasurer; Joseph Herrmann, John Blair and Ed Riesmeyer, Jr., Board of Governors.

Explaining transmission as the sending of a signal or information to a remote point where the information is acted upon, John Traynor spoke on graphic control centers and pneumatic transmission at the

CHAPTER MEETING DATES

	May	June
Alamo	17	21
Arkansas	18	15
Atlanta	—	—
Austin	19	16
Baltimore	5	—
Baton Rouge	19	—
Boston	17	—
British Columbia	11	—
Central Arizona	2	—
Central Indiana	10	—
Central Michigan	10	14
Central New York	11	—
Central Oklahoma	9	—
Central Pennsylvania	—	—
Cincinnati	—	—
Cleveland	9	—
Columbus	16	—
Dallas	16	20
Dayton	—	—
El Paso	9	—
Evansville	3	4
Florida West Coast	17	21
Fort Worth	18	15
Golden Gate	5	2
Hampton Roads	—	10
Houston	20	17
Illinois	9	—
Illinois-Iowa	16	—
Inland Empire	10	14
Iowa	10	—
Jacksonville	3	7
Johnstown	10	—
Kansas City	2	—
La Ville de Quebec	9	13
Long Island	9	13
Louisville	9	—
Manitoba	—	—
Memphis	15	—
Michigan	24	—

March 21st meeting. This signal or information can be recorded, indicated or used as a control. Control center was defined as a central point where a transmitted signal is measured, logged, evaluated and acted upon. These centers are used to indicate, record and control temperature, humidity and other actions of mechanical equipment.

IOWA . . . During his talk on the Ames Laboratory, Dr. Morton Smutz of Iowa State University discussed the history of atomic energy, organization of the Institute for Atomic Research and the Ames Laboratory at Iowa State University, physical plant layout and past and present projects of the laboratory, and problems of disposal of atomic waste.

BRITISH COLUMBIA . . . Proposed officers for the 1960-61 season, as presented by the Nominating Committee, include: W. F. Wiggins, President; D. B. Leaney, 1st Vice President; R. W. Hole, 2nd Vice President; William Baker, Secretary; M. J. Phillipson, Treasurer; and Frank Dwyer and R. S. Miller, Board of Governors.

"Selection, Application and Performance of Refrigerant Control Valves on Air Conditioning Systems" was the topic discussed by J. A. Schenk, Director of Engineering, Alco Valve Company, guest speaker at the March 16th meeting.

CENTRAL MICHIGAN . . . Submitted by the Nominating Committee for inclusion on the ballot of officers for the 1960-61 season were: Walter Hassenplug, President; Roy Wick, 1st Vice President; John Jennings, 2nd Vice President; Clifford Knudson, Treasurer; Henry Krueger, Secretary; and James Gire, Richard Wright and Frank Grotser, Board of Governors.

Preceding the main speaker of the evening, James Gire discussed "Application of Capillary Tubes to Remote Residential Cooling Units."

Telling of past, present and possible future designs in the field of domestic refrigerators and freezers, Fred L. Tarleton, Manager of Refrigeration Engineering for Hotpoint Company, presented the main talk of the evening on "Domestic Refrigeration Design and Application."

WESTERN MICHIGAN . . . Stating that the refrigeration and air conditioning industries desire smaller size, less weight and lower cost in compressor mtors, speaker Don Cochran of General Electric Company contended, in his address at the March 14th meeting, that a two-pole motor of 3450 rpm would fill these requirements better than further development ot the four-pole 1725 rpm motors. This development required the investigation of 50 different parameters, such as wire diam, insulation, space factors, slot types and skew. After these calculations were made, cost analysis of the several most efficient combinations of these factors were made. Development such as this, stated the speaker, has reduced stator diam of 1/5 to ½-hp motors from 6¼ to 4⅞ in. with considerable reduction in cost.

SOUTHERN CALIFORNIA . . . Several reasons exist for use of Refrigerant 22 rather than Refrigerant 12 in residential air conditioning equipment, according to Charles A. Dubberley of General Electric Company, March guest speaker. Refrigerant 12 does not possess characteristics required by the various types of residential units, is cited as decomposing 100 times faster than Refrigerant 22 in the presence of oil, copper and iron at 250-300 F and only 2/3 as much Refrigerant 22 as 12 is needed per ton of system refrigeration.

Five loads imposed upon hermetic compressors as used in heat pumps and air conditioning units were listed by him: suction pressure, discharge pressure, suction gas superheat, voltage and ambient. Slides of grafts were used to show how these loads are viewed by the compressor. 300 F was indicated as being the highest temperature at which to operate oil and refrigerant in a system.

LOUISVILLE . . . First Joint Technical Conference sponsored by the Technical Committee of this Chapter and the University of Louisville was held February 17th. Topic of the seminar was "Applications of Peltier Refrigerating Machines", presenting the results of investigations conducted by Chapter members. Prepared talks were given by Frank Schumacher of General Electric Company, Stig Sylvan of American Air Filter Company and E. B. Penrod of the University of Kentucky. Discussion from the floor followed the three presentations. Organization of the meeting was by Larry Czerwonka of American Air Filter, who also acted as Chairman.

Application of the Peltier material to a working machine was displayed by speaker Schumacher, who discussed the theory in terms of material characteristics and methods of application. Material covered was bismuth telleride; his comments were concerned with both the calculation procedure for determining design performance and with some of the mechani-

	May	June
Middle Tennessee	10	—
Minnesota	9	—
Mississippi	23	27
Mobile	23	27
Montreal	16	13
National Capital	—	—
Nebraska	10	—
New Mexico	17	21
New Orleans	17	—
New York	24	—
Niagara Peninsula	3	7
North Alabama	—	—
North Jersey	5	2
North Piedmont	—	—
Northeastern New York	17	—
Northeastern Oklahoma	16	—
Northern Alberta	18	9
Northern Connecticut	12	—
Northern Ohio	—	—
Ontario	—	—
Oregon	12	16
Ottawa Valley	17	—
Panama & Canal Zone	10	14
Philadelphia	12	—
Pittsburgh	—	—
Puget Sound	10	—
Rhode Island	18	—
Richmond	2	—
Rochester	—	—
Rocky Mountain	—	—
Sacramento Valley	4	1
St. Louis	23	—
San Diego	10	14
San Joaquin	17	21
Savannah	17	14
Shreveport	19	16
South Carolina	16	20
South Florida	10	14
South Piedmont	—	—
Southern Alberta	17	—
Southern California	9	13
Southern Connecticut	10	14
Toledo	2	—
Tucson	—	—
Utah	21	17
West Texas	23	27
Western Massachusetts	16	—
Western Michigan	—	—
Wichita	17	—
Wisconsin	16	—

cal, Peltier and toxicity characteristics of the material. Shown by him were several models illustrating method of construction in an actual refrigerator.

A theoretical study made some time ago for the application of Peltier cooling to refrigeration of living spaces was discussed by Sylvan, who carried the calculation to the point where he was able to estimate hp requirement for refrigeration produced. With the materials available at the time of his investigation, the resulting Peltier machine was not competitive in terms of power consumption with existing equipment.

Professor Penrod's talk was concerned with physical reasoning for determining the distribution of Joule heat between the hot and cold junctions of a thermopile.

A second symposium sponsored by the Chapter's Technical Committee and the University of Louisville, as yet unreported upon, was scheduled for March 16th. Title of the seminar is "Technical Approach to Cooling Loads with Respect to Chapter 13, ASHRAE Guide 1959". A 30-min presentation of cooling loads by a speaker was to be followed by a technical panel discussion, with Harold Carr of Carr, Roy and Associates as Moderator.

MEMPHIS . . . Subject under discussion at the March 22nd meeting was "Reactions of Man to Inside Environments", presented by Burgess Jennings, ASHRAE Director of Research. His talk concerned the Research Laboratory, its history, current activities and future plans. Noted was that the comfort chart in the Guide was based on short term occupancy and was obtained by moving subjects from a warm dry room to a cool moist room, constantly adjusting conditions until the subjects felt the same degree of comfort in both rooms. A new chart has been prepared from experiments based on long term occupancy. Radiation effect during the experiments was minimized by maintaining surface temperatures in close proximity to room dry bulb. It was found that air motions as low as 30 fpm required an increase of 2 F above the optimum conditions to maintain the same degree of comfort.

Work is now being conducted to determine the optimum condition for productivity—that condition beyond which no increase in productivity of a worker can be detected. This research will be extended to determine the optimum classroom condition and effects upon the learning capacity of students.

ILLINOIS . . . Detailing past and present work of the ASHRAE Research Laboratory in Cleveland, Burgess Jennings provided a Coffee Talk at the March meeting. Over the years, the laboratory has accomplished work in various fields, some of which are: comfort chart, air cleanliness, knowledge of building materials, heating and cooling loads, panel cooling and noise investigation. At present, research is being conducted on environments.

Various types of refrigeration machines available today were discussed by guest speaker Littel of Carrier Corporation in an address illustrated with slides. From a Carrier-conducted survey it was shown that, as far as economical operation is concerned, the break-even point in use of reciprocal and centrifugal equipment is at 100 ton. Under this size, reciprocal units are used, while over 100 ton, centrifugal compressors in the form of open or hermetic units or steam absorption units should be used. At the present time, absorption units are available only up to 1000 ton.

Littel then explained in detail the differences between three types of large refrigeration machines available and pointed out their inherent advantages and disadvantages. By means of a typical problem, he showed how it is possible to determine which machine is most economical in a given situation. A careful analysis of many aspects is necessary, considering such factors as initial, installation, operating and power supply costs and maintenance expenses.

Concluding the evening's program, Burgess Jennings spoke on fluid flow. Mentioning that, in low pressure steam systems with low velocity steam, condensation could be drained in the usual manner, he stated that 37 fps seems to be the critical dividing point. As tubing increases in size, critical velocity increases. Below critical velocity, condensation stays in the bottom of the pipe. Above it, water follows the steam.

Noise in hot water heating systems was discussed with use of slides. Restriction in a water line was seen to increase noise as restriction increased. Speaker Jennings stated that noise in hot water systems can sometimes be overcome by running the fluid through the larger cross-section pipe.

NORTHEASTERN OKLAHOMA . . . Definitions and explanations of pump terminology introduced the talk on application of centrifugal pumps to heating and cooling systems presented by Ralph W. Janetz of Bell & Gossett Company at the March 21st meeting. Four steps in determining the correct pump for a specific installation were cited by the speaker: determination of system load and gap requirements; of system pressure drop, with emphasis on calculation of head loss, allowing for present and future demands on the system; and of total dynamic system head; and selection of the correct pump from the manufacturer's pump curves. Generally accepted methods of testing pump performance were discussed and then a question and answer period was initiated by the speaker.

PUGET SOUND . . . Submitted as candidates for office for the 1960-61 season were M. R. Overbye, President; K. G. Massart, 1st Vice President; J. M. Tupper, 2nd Vice President; David Hopkins, Secretary; D. J. Moore, Treasurer; and Dixon Ervin, Henry Bickel and F. A. McDonald, Board of Governors.

Speaking on "Selection, Application and Performance of Refrigerant Control Valves on Air Conditioning Systems and Heat Pumps" was John A. Schenk, director of Engineering of Alco Valve Company.

NEW YORK . . . High temperature hot water heating systems are being utilized with increasing frequency and have proved advantageous for applications serving many buildings spread over a large area. Such was the case at the U. S. Air Force Academy at Colorado Springs, Colo. A project of

extensive size, the Academy combines a university, military base and self-contained city, providing all the facilities and services associated with these three elements. Heating systems for this complex had to be both efficient and economical. Problems of a special nature were encountered in its design, resulting mainly from the distances traversed by the distribution system and the nature of the terrain itself.

Presenting an outline of the problems which had to be reconciled, an economic analysis of the various types of heating systems considered and a discussion of the actual design steps in planning of this installation, Erwin G. Hansen, Manager–Supertherm Dept., J. O. Ross Engineering, was guest speaker at the March 29th meeting.

NORTH JERSEY . . . Names proposed by the Nominating Committee as officers for the 1960-61 season are: George Freeman, President; C. D. Parmelee, 1st Vice President; Herbert Wolf, 2nd Vice President; Clifford Zimmer, Secretary; Lester Lieberman, Assistant Secretary; and R. S. Taylor, Treasurer.

Common basis for designing an air conditioning system is to assume the compressor running at max capacity. In actuality, this is rarely the case. Members involved in a pre-dinner seminar at the March 10th meeting, at which Melvin Ramsey of Worthington Corporation presided, contended that basis must be made with the realization that the compressor will run between max and min capacity.

Later in the evening Robert Bald, Carrier Corporation, described a method, based on an economic analysis, for correct selection of refrigerating machines for air conditioning applications. Comparison included hermetic and turbine type centrifugal, absorption and reciprocating designs.

PHILADELPHIA . . . Held on March 26th was the first annual Refrigeration Seminar of this Chapter, with Otto Nussbaum as Moderator. ASHRAE officers in attendance were J. Everetts, Jr., 3rd Vice President, and Earle K. Wagner, Region III Director.

Opening the meeting was a slide-illustrated discussion of basic refrigeration principles. Water and refrigerant were made to boil through use of a vacuum pump, demonstrating the refrigerant effect. Direct expansion systems were reviewed, including selection and application of system components such as air handling units and air-cooled and evaporative condensers. Following this was a discussion on packaged chillers, their requirements and applications. After a review of coil units for chilled water systems, the seminar was concluded with a demonstration of brazing.

NEW ORLEANS . . . Discussing conditions experienced in cooling towers in operation at his plant, J. Clifton Hill of the Baton Rouge Refinery of Esso Standard Oil Company spoke on "Water treatment and Cooling Tower Deterioration" at the March 15th meeting. Towers mentioned range from 15-ton upwards.

In efforts to control algae, speaker Hill stated, copper salts were not found to be effective, pentachlorophenal compounds giving the best results in medium size towers. In larger towers, chlorine treatment was found to be satisfactory, although deterimental to wood towers. Control of scale was cited as offering no problem in this installation, since most of the water used comes from wells and is relatively soft.

Tests conducted to determine the type of wood and wood treatment which would give the best service showed redwood to be superior to fir and pine. Redwood treated by the Erdalith pressure treatment was cited as offering max resistance to deterioration under climatic conditions in that area.

RICHMOND . . . F. Weiss, President; Milton Alley, Vice President; Allen Miller, Secretary; J. C. Turlington, Treasurer; and C. H. Imel, H. A. Garber and G. J. Wachter, Board of Governors, were elected as officers for the 1960-61 season, announced at a meeting of the Executive Committee held March 7th.

At a regular meeting of the Chapter, held March 4th, guest speaker Rhoades of Babcock & Wilcox Company presented a slide-accompanied talk on nuclear heating installations.

COLUMBUS . . . . Although electronic air cleaners have been used for some time in commercial and industrial installations, there has been increased research and development activity by manufacturers interested in refining and simplifying the equipment for domestic applications. Acquainting members and guests attending the March 21st meeting with basic principles of electronic air cleaning, its application and future was Paul G. Andrus of Battelle Memorial Institute.

SAN DIEGO . . . An exhibit planned for Engineer's Week will include a working model of a refrigeration cycle, information on relation of lighting loads to refrigeration capacity and a chart comparing the efficiency of personnel in air conditioned and non-air conditioned buildings.

Comparing the use of a compressor stage system with a cascade system for low temperature applications, Dale Missimer, Vice President of Missimer's Inc., spoke on "How to Pump Heat at −100 F" at a recent meeting. Practical aspects were stressed.

SACRAMENTO VALLEY . . . Covering the principle of flame failure devices and their design and operation, Russ Green of Minneapolis-Honeywell Regulator Company was guest speaker at the March 2nd meeting. Emphasis was placed on the role of flame failure protection in the prevention of explosions and how such equipment provides the necessary sequencing for proper burner operation. Included in his discussion were flame rods, photoelectric cells, lead sulphite cells and ultra-violet cells.

CHAPTERS REGIONAL COMMITTEE MEETINGS AHEAD

REGION II, Northern Alberta Chapter (Edmonton), June 8
REGION III, Richmond Chapter (Williamsburg), Oct. 22-23
REGION VIII, Alamo Chapter (San Antonio), May 9
REGION IX, Utah Chapter (Salt Lake City), May 4
REGION X, San Joaquin Chapter (Fresno), May 6-7

JOHNSTOWN . . . Lacking two past Presidents eligible to serve on a five-member Auditing Committee, as required by new By-Laws, this Chapter elected a four-member committee consisting of E. D. Grabe, M. J. Hostetler, W. W. Popyk and W. L. Ross.

Basic fundamentals of coal burning were covered at the March meeting by Dr. Arthur A. Orning, Chief of the Combustion Sect, U. S. Bureau of Mines, who also spoke briefly on tube corrosion. Most of his discussion centered on commercial applications of coal firing, especially in power plants.

CENTRAL ARIZONA . . . Program for the March meeting was a question and answer period with the Plumbing, Electrical, Building and Mechanical Inspectors of the Div of Building Inspection replying to members' queries.

EVANSVILLE . . . Dr. C. T. Ashby, President of Conrad, Inc. and a past Chairman of this Chapter spoke at the March meeting on "Environmental Chambers".

HOUSTON . . . Refrigerant distributors were covered by Robert Niedermeier of Sporlan Valve Company, speaker at the March 18th meeting.

KANSAS CITY . . . Discussing the meaning of the terms "Professional Engineer" and "Registered Engineer", A. C. Kirkwood of A. C. Kirkwood and Associates spoke on "Unity in your Profession" at the March 7th meeting. He noted that many companies are encouraging their employees to become registered engineers, and traced the development of registration laws from their beginning in Wyoming in 1908 to the present time. Stating that unity in the profession is only partial or limited, he expressed the contention that engineers must integrate their efforts in raising the standing of the profession.

PANAMA & CANAL ZONE . . . Members attending the March meeting saw a film and heard a taped talk on compressor rebuilding, prepared by Carrier Corporation. After the film, discussion was held concerning the unloading feature of these compressors.

CENTRAL NEW YORK . . . Speakers J. Murray Hueber of Peterson, Hueber, Hares & Glavin and Robert Miller of Robson & Moses discussed school air conditioning at the March 9th meeting, with emphasis on Clary Junior High School, currently under construction in Syracuse.

CENTRAL OKLAHOMA . . . Discussing air filters for atmospheric dust, James May of American Air Filter Corporation covered both the makeup of such dust and various filters available for its removal, in his talk at the March 14th meeting.

MINNESOTA . . . Nominees for Chapter offices for the 1960-61 season are: Donald F. Swanson, President; John V. Borry and J. W. McNamara, Vice President; R. M. Jack and Merland Kispert, Secretary; Rollin S. Chapple and R. L. Peterson, Treasurer; and J. E. Haines, L. D. Freedland and C. E. Lund, Board of Governors.

For the March 14th meeting, the speaker was Robert E. Miller of York Corporation, who discussed the "Lithium Bromide Absorption System."

ROCKY MOUNTAIN . . . "Liaison Between Engineering and Marketing" was the topic of D. G. Faust, Vice President of Marketing, C. A. Norgren Company, guest speaker at the March meeting. Presenting steps in development of a product, through research, planning, development, production, selling and service, he placed special emphasis on communication between engineering and marketing before production.

JACKSONVILLE . . . Nominating Committee proposed officers for the 1960-61 season as follows: Paul Stewart, President; John Kirkpatrick, Vice President; Frank Griffo, Treasurer; Al Duffek, Secretary; and Roy Greelish and Jack Ayars, Board of Governors.

Speaker of the evening was Robert Nichols, who presented an address on weather.

NATIONAL CAPITAL . . . Nominees for offices for the 1960-61 season are: H. E. Grossman, President; W. C. Hansen, Vice President; H. R. Henke, Secretary; R. J. Ruschell, Treasurer; W. V. McCoy, Assistant Secretary; and J. J. Nolan, G. W. Campbell and Louis LaForet, Board of Governors.

DALLAS . . . Speaking at the March 21st meeting, Howard F. Carter of Chance Vought Aircraft had as his topic "Missile Cooling Systems".

MISSISSIPPI . . . Historical development of absorption air conditioning up to units currently in production and being tested by his company was discussed by Alan Davis of Arkla Air Conditioning Corporation, guest speaker at the March 28th meeting.

MOBILE . . . "Evaporative Condensers, their Theory, Construction and Application" was the subject of William E. Kahlert, Vice President of Baltimore Aircoil Company, when he spoke at the March 28th meeting.

BATON ROUGE . . . Air conditioned by a gas absorption system using chilled water and multizone units, the United Gas Building in Lafayette, La., was the site of a tour conducted March 16th.

AUSTIN . . . Robert Niedermeier of Sporlan Valve Company spoke at the March 17th meeting on "Expansion Valves, their Selection and Application."

SAN DIEGO . . . At the March 8th meeting, the following nominations were made for officers for the 1960-61 season: President, S. Bayne; Vice President, M. Jackson; Secretary, C. Deilgat; Treasurer, C. Butcher; and Board of Governors, K. Flocke, K. Klein and W. Sulloway.

BULLETINS and CATALOGS

Gas Heaters. Information on an expanded line of Safti-Vent gas heaters and this manufacturer's new Desert Sun line of vented recessed gas heaters and gas vented radiant circulators is contained in a group of four bulletins, eight-page LB396 and four-page LB415, LB393 and LB394. Sealed Safti-Vent units are now manufactured in cabinet and recessed wall models and a window-installed unit. Featured in the Desert Sun line is a separate heater plate which may be installed at rough-in time and finished plaster or wall board applied. Installation is later completed by sliding the flue outlet through the opening in the header plate, swinging the heater into the wall opening, and fastening it in place. Cutting and fitting are eliminated and the heater is kept free from construction debris.
H. C. Little Burner Company, Inc., San Rafael, Calif.

Ice-making Machines. Describing modern ice-making machines and how to use them, this 48-page booklet, "New Ideas on Ice", contains detailed information on this line of more than 60 models of cubers, flakers, storage bins, crushers, drink dispensers that manufacture their own ice and coin-operated ice vendors. Capacities range from 50 lb to more than two ton of ice per day.
Scotsman Ice Machines, Queen Products Div, King-Seeley Corporation, Albert Lea, Minn.

Multizone Units. Extensive engineering data, dimensions and specifications for the entire series of multizone units, which are equipped for simultaneous heating and cooling applications, is found in Catalog 55C9a. Units are available with capacities from 1650 to 29,000 cfm, modular construction permitting a wide choice of arrangements, motor locations and accessories for either horizontal or vertical models.
Recold Corporation, 7250 E. Slauson Ave., Los Angeles 22, Calif.

Low Voltage Equipment. Covering low voltage distribution equipment, the 1960 edition of this company's Buy Log (84-page Bulletin GEC-1100B) is designed to serve as a condensed buying catalog for products which include service entrance equipment, light and heavy duty safety switches, tumbler and open-knife switches, circuit breakers, motor control centers, sectional distribution centers and all types of panelboards and busway. Features of the bulletin are: selector charts for each type of product, pictorial descriptions, consolidated pricing tables and a cross-reference catalog number index. Also included are ratings, weights, dimensions, standard package quantities, ordering directions and several pages of general application information.
General Electric Company, Plainville, Conn.

Ammonia Circulation System. To achieve a semi-flooded liquid control in direct expansion coils without the use of pumps, this centralized ammonia circulation system produces a constant pressure plant feed with circulation rates up to three times the evaporation rate, and is adaptable to existing plants as well as to new construction. Several arrangements have been developed for single and multiple stage plants. Information on this system is contained in Bulletin LCS-60.
H. A. Phillips & Company, 3255 W. Carroll Ave., Chicago, Ill.

Motor Controls. Principle of "Right Angle" design of these controls is explained and reduction in size and weight of the units is discussed in six-page Bulletin A-262. Also provided are brief explanations of technical and design features of a line of starters and contractors. Nema sizes zero through five are pictured, with several of the enclosure types available.
Arrow-Hart & Hegeman Electric Company, 103 Hawthorn St., Hartford 6, Conn.

Control Centers and Systems. Advantages of this line of control centers for combustion safeguard and automation are given in 24-page Bulletin C11, which also includes product descriptions and illustrations. Design data are listed and starting sequence tabulations presented.
Webster Engineering Company, a subsidiary of Midland-Ross Corporation, Tulsa, Okla.

Foam Producing Equipment. To supplement a line of polvurethane foam machinery, this manufacturer has developed a Miniature Model small-shot production unit capable of pumping, metering and mixing two component formulations for rigid, semi-rigid or flexible foams. Throughput is variable from zero to two lb/min. Descriptive of construction and operation of the unit is a six-page folder.
Martin Sweets Company, Inc., 114 S. First St., Louisville 2, Ky.

Aluminum Joining Manual. Included in this 40-page bulletin is an extensive survey of aluminum welding, brazing and soldering. Contained are twelve charts on composition of aluminum alloys, their technical and physical properties, and recommended filler alloys for MIG and TIG welding. In addition, composition and properties of this manufacturer's line of brazing filler alloys and melt and flow charts are given. Among subjects covered are welding aluminum and its alloys by inert gas shielded metal arc with a consumable electrode, inert shielded metal arc with a tungsten electrode and latest arc and gas welding processes.
All-State Welding Alloys Company, Inc., 249-55 Ferris Ave., White Plains, New York.

Reflective Insulation. Presented in this 28-page bulletin, "The Story of Reflective Insulation," is current information on techniques of home and industrial insulation, together with an explanation of the dynamics of heat transfer, thermal efficiency and condensation. Drawings and text show the mechanics of three basic methods of heat transfer, convection and conduction. Charts and tables indicate comparative thermal efficiency of various insulation materials.
Reflectal Corporation, a subsidiary of Borg-Warner Corporation, 200 S. Michigan Ave., Chicago 4, Ill.

Multi-Zone Air Conditioners. Illustrated and described in four-page Bulletin 8625 are both the single-zone basic unit and the multi-zone design of this new line of packaged air conditioners. Design features are itemized and presented in detail. Basic specifications and dimensions are tabulated.
American Radiator and Standard Sanitary Corporation, Industrial Div, Detroit 32, Mich.

Flexible Air Duct. Selection guide to six types of duct contains information on where to use it, specifications and typical installations. Sections on engineering features and installation methods are included in four-page Bulletin No. 622. Covered are air

(*Continued on page* 96)

Candidates for ASHRAE Membership

Following is a list of 160 candidates for membership or advancement in membership grade. Members are requested to assume their full share of responsibility in the acceptance of these candidates for membership by advising the Executive Secretary on or before May 31, 1960 of any whose eligibility for membership is questioned. Unless such objection is made these candidates will be voted by the Board of Directors.

Note: * Advancement † Reinstatement

REGION I

Connecticut

BRODIE, W. P., Sales Service Engr., Brodie Restaurant Supplies, New Haven.
BURR, K. G., Engr., Van Zelm, Heywood & Shadford, West Hartford.
GOULD, R. C., Sales Mgr., Westville Electric Co., New Haven.

Massachusetts

CRONIN, M. F., Maint. Group Leader, Raytheon Co., Newton.
CROWLEY, C. A., JR.,* Chief Engr., Francis Associates, Marion.
FABIO, F. A., Contr. Sales Engr., Powers Regulator Co., Boston.

New Hampshire

FULLER, W. R., Director & Owner, Fuller Engineering Consulting Service, Concord.

New Jersey

BILLIG, MICHAEL, Sales Engr., Minneapolis - Honeywell Regulator Co., Union.
KEMBER, F. P., Dist. Sales Mgr., Carrier Corp., Clifton.
ROBINS, EDWIN,* Mech. Designer, Morrison, Zimmer & Burton, Union.

New York

ANDERSON, WILLIAM, Appl. Engr., Owens-Corning Fiberglas Corp., New York.
BELLUCCI, A. R., Service Mgr., Republic Air Conditioning Corp., Hempstead.
BENNETT, H. S.,* Mech. Engr., Albert S. Hartheimer, Albany.
BURKE, R. M., Vice-Pres., Sales, Corning Air Conditioning, Inc., Syracuse.
CELANO, E. W., Sales Engr., Minneapolis - Honeywell Regulator Co., Syracuse.
DODDS, R. G., Mgr. Htg. Equipment, Prod. Engr., Carrier Corp., Syracuse.
DROZ, J. J.,† Owner, Governed Air Inc., Whitesboro.
GILMARTIN, B. F. JR., Salesman, Industrial Insulation, Owens-Corning Fiberglas Corp., New York.
HASSETT, M. F., Owner, Hassett Heating & Fuel Oil Co., Huntington Sta.
HIGHAM, W. S., Sales Engr., Bell & Gossett Co., Inc., New York.
JOHNSON, A. W., Industry Arch. Consultant, National Mineral Wool Association, New York.
JONES, F. R., Sales Engr., Farr Co., New York.
KLEIN, I. D., Pres., Designed Weather Dist., Mineola.
MOLIER, ALFRED, Htg. & Cooling Calculator, Sperry Gyroscope Co., Great Neck.
NEWTON D. A., Sales Engr., Newton Engineering Co., New York.
NEWTON, G. P.,* Design Engr., Sargant Webster Crewshaw Follay, Syracuse.
SINGER, NORMAN, Assoc., Jaros, Baum & Bolles, New York.
SPIEGEL, DANIEL,* Chief Engr., Brandt Corp., Long Island City.
WAWRZASZEK, S. H., Sales Engr., American Blower, American-Standard, Industrial Div., Syracuse.
WRIGHT, T. A., Dvlpt. Engr., Carrier Corp., Syracuse.
ZAMUNER, NAZZARENO, Engr., S. W. Brown Consulting Engineers, New York.

Rhode Island

GUNDERSON, R. M., Sales Repr., Trane Company, West Barrington.

REGION II

Canada

ARSENAULT, R. J., Mech. Design Engr., Letendre, Monti & Assoc., Montreal, Quebec.
BARTNICKI, A. W., Engr., Canadian National Railways, Winnipeg, Man.
BIRCH, CHARLES, Estimator, Northwest Ventilation & Industries, Ltd., St. James, Man.
BUCHANAN, J. D., Pres. & Gen. Mgr., Thermal Refrigeration Contracting Ltd., Hamilton, Ont.
CARRICK, M. A., Sales Estimator, Dunham-Bush (Canada) Ltd., Toronto, Ont.
CHASSE, ROLAND, Cons. Engr., Hauterive, Quebec.
CLEGG, R. J., Secy-Treas., Clegg-Dunn Plumbing & Heating Ltd., Edmonton, Alta.
COCKRAM, P. R., Owner, W. Cockram & Co., Ltd., Paris, Ont.
DUBASH, S. D., Proj. Engr., J. Klassen & Associates Ltd., Ottawa, Ont.
GIFFIN, D. M., Chief Engr., Dunham-Bush (Canada) Ltd., Weston, Ont.
GRAVELSINS, JOHN, Mech. Dept., Head, Surveyer, Nenniger & Chenevert, Montreal, Quebec.
HALL, R. L., Sales Engr., Dunham-Bush (Canada) Ltd., Westmount, Quebec.
HOOD, C. H., Sales Engr., Douglas Engineering Co., Ltd., Montreal, Quebec.
JOHANNSON, J. I., Sales Repr., Westinghouse, Sturtevant Div., Town of Mt. Royal, Quebec.
LEMOINE, R. S., Sales Mgr., Douglas Engineering Co., Ltd., Ottawa, Ont.
LILL, G. E., Water Tube Boilers-Steam Storage Repr., Dominion Bridge Co., Ltd., Toronto, Ont.
MACKAY, W. J., Engr., Johnson Service Co., Arvida, Quebec.
MACKENZIE, K. C., Indus. Sales Engr., Canadian Ice Machine Co., Ltd., Montreal, Quebec.
MORGAN, G. B., Design Engr., Hamilton Plumbing & Heating Supplies, Ltd., Toronto, Ont.
PARR, B. E., ESO, RCAF., Montreal, Quebec.
PENSTONE, DOUGLAS, Sales Repr., Crane Associates, Ottawa, Ont.
SCHJERNING, M. C., Design Engr., Greensteel Industries Ltd., Winnipeg, Man.
SCHOOLEY, K. F., Dist. Engr., Canadian Ice Machine Co., Ltd., Montreal, Quebec.
SWEENEY, D. J.,* Br. Mgr., Trane Company of Canada, Ltd., Toronto, Ont.
VARNER, R. H., Dist. Tech. Repr., Honeywell Controls Ltd., Edmonton, Alta.
ZURBRIGG, R. A., Dist. Sales Mgr., Canadian Westinghouse, Sturtevant Div, Hamilton, Ont.

REGION III

District of Columbia

MARKS, C. H.,† Chief Engr., National Coal Association, Washington.

Maryland

CHASNEY, PETER, Owner, Towsen.
DIGIACOMANTONIO, DOMENIC, Estimator, Wesley-Freeman, Inc., Baltimore.
ROE, E. L., Estimator, Wesley-Freeman Inc., Baltimore.
RONEMOUS, V. B., Sales Engr., R. H. Bozman & Bros., Baltimore.
SCHANKEN, F. E. SR., Architect, Drafting, Lloyd E. Mitchell, Inc., Baltimore.

Pennsylvania

BARBIERI, J. R., Owner, John Barbieri Co., Philadelphia.
BUZZA, H. C., Mgr., H. C. Buzza Co., Schuylkill Haven.
HARBAUGH, R. J., Engr., Bell Telephone Co., Pittsburgh.
ROESCH, F. A., Vice-Pres., Tri-City York Co., Inc., Catasauqua.
ZEINER, G. O., Gen. Mgr., Larson Supply Co., Allentown.

Virginia

TAYLOR, C. M., Appl. Engr., Brennon-Stacey, Inc., Richmond.

REGION IV

Florida

FULLER, E. H., Repr., Mote W. Baird & Son, Inc., St. Petersburg.
WHIDDEN, C. W., Instructor, Dept. Mech. Engr., University of Florida, Gainesville.

North Carolina

KAMP, J. F., Sales Engr., American-Standard, Industrial Div, Charlotte.

REGION V

Indiana

COOK, J. P., Sales Engr., American-Standard, Industrial Div, Ft. Wayne.
HAMMOND, J. M., Br. Mgr., American-Standard, Industrial Div, Ft. Wayne.
KERCHEVAL, W. L.,* Prod. Appl. Engr., Pfau-Vogel Co., Indianapolis.
WHITE, H. C., Sr. Maint. Engr., Mead Johnson & Co., Evansville.

Ohio

BRAINARD, J. A., Sales Engr., H. K. Porter Co., Inc., Cleveland.
BUKOWITZ, M. D., Sales Engr., American-Standard, Industrial Div, Cincinnati.
COHRON, L. P., Elec. Htg. & Cooling Specialist, Cincinnati Gas & Electric Co., Cincinnati.
COOK, H. A.,† City Bldg. Inspector, City of Springfield, Springfield.
KRESINA, GEORGE, Assoc. Salesman, Cleveland Electric Illuminating Co., Cleveland.
MANSBACH, A. H., Designer, Austin Co., Cleveland.
STOFFEL, FRANKLYN, Mgr., Owner, Frank Stoffel Equipment Co., Columbus.
WALKER, W. J., Dvlpt. Engr., Loren Cook Co., Berea.

REGION VI

Illinois

MILLER, E. J., Chief Operating Engr., Continental Illinois National Bank, Chicago.
NELLIGAN, J. W., Design Engr., E. R. Gritschke & Assoc., Inc., Chicago.
PARMELEE, R. L., Appl. Engr., Minneapolis - Honeywell Regulator Co., Peoria.
STRICKLAND, E. E., Pres., Strickland Htg. & Air Cond. Inc., Peoria.

Michigan

KOETS, H. G., Vice-Pres., Wheeler-Blaney Co., Kalamazoo.
MOTE, C. A., Plant Engr., National Bank of Detroit, Detroit.
OTTNEY, R. R., Sales Engr., D. T. Randall & Co., Ferndale.

Minnesota

GRICE, K. H., Estimator & Installation Supvsr., Snelling Co., St. Paul.
MCLELAND, R. B., Htg. Engr., Lindsay Bros. Co., Minneapolis.

Wisconsin

OXENRIDER, MARION,† Process Engr., American Motors, Kenosha.

REGION VII

Alabama

JACKSON, T. A., Sales Engr., Minneapolis - Honeywell Regulator Co., Birmingham.
WILSON, A. C., Owner, A. C. Wilson Agency, Mobile.

Kentucky

DANUSUGONDHO, ISKANDAR, Special Graduate Student, University of Kentucky, Lexington.

Louisiana

GRANGER, DENIS JR., A-C Sales Engr., United Gas Corp., New Iberia.

Missouri

BALLARD, C. P. JR., Engr., U. S. Army Transportation Corps, St. Louis.
PRICE, B. S., Sales Mgr. & Estimator, Ratican Insulation Co., St. Louis.

Tennessee

BUCHI, H. U., Vice-Pres., Buchi Plumbing Co., Nashville.
TUDOR, J. A., Sales Engr., Trane Company, Nashville.
WHITTEMORE, W. M. JR.,† Indus. Sales Engr., John Bouchard & Sons Co., Nashville.

REGION VIII

Arkansas

MEDLIN, SCOTT, Pres., Medlin Plumbing & Heating Co., Little Rock.

Oklahoma

BALDWIN, C. B., Sales Engr., Federal Corp., Oklahoma City.
BOGLE, W. J., Sales Trainee, Oklahoma, Natural Gas Co., Oklahoma City.
SOCIN, B. A., Owner, Kamsco, Oklahoma City.
VON GONTEN, J. R., Pres., Comfort of Tulsa, Inc., Tulsa.
WALLIS, J. E., Sales Engr., Trane Co., Oklahoma City.

Texas

DAVIS, J. W., Part Owner, Sarsco, San Antonio.
ELZNER, J. D., Repr., Johnson Supply, Houston.
MARTIN, O. W., Repr., Johns-Manville Sales Corp., San Antonio.
MILLER, H. T., JR., Br. Mgr., Armstrong Contracting & Supply, San Antonio.
MINNER, K. E., Mech. Engr., Butler-Kimmel Co., Lubbock.
PAUSKY, A. W., Mech. Engr., USAF, Randolph AFB.
SIMON, H. L., Sales Engr., Trane Company, San Antonio.
THOMPSON, R. D., Estimator, Bell-Kotzebue Co., San Antonio.

REGION IX

Kansas

SNYDER, R. R.,* Engr., General Air Conditioning & Electrical Co., Salina.

Nebraska

ROUBAL, J. P., Design Engr., Leo A. Daly Co., Omaha.
UPHAM, R. W.,† Chief A-C. & Refr. Section, HQ Strategic Air Command, Deem Offutt AFB.

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5 Models — 2 to 10 Tons

COOLS OR HEATS - DEHUMIDIFIES - FILTERS - CIRCULATES AIR

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- Larkin air-conditioning coil—eight fins per inch, continuous fin, staggered tubes, for highest efficiency, lowest operating cost
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DIRECT EXPANSION RATINGS 80° D. B. 67° W. B. Ent. Air, 40° Ref. Leaving Air					*Dimensions*		
Model No.	*CFM*	*Tons*	*D.B.*	*W.B.*	*Height*	*Width*	*Depth*
AH-2	800	2.06	61.8	57.4	22¾	30	46⅞
AH-3	1200	3.27	60.7	56.8	22¾	35	46⅞
AH-5	2000	5.39	61.0	56.9	22¾	50	46⅞
AH-8	3000	8.16	60.7	56.8	25¾	61	46⅞
AH-10	4000	10.88	60.7	56.8	31¾	61	46⅞

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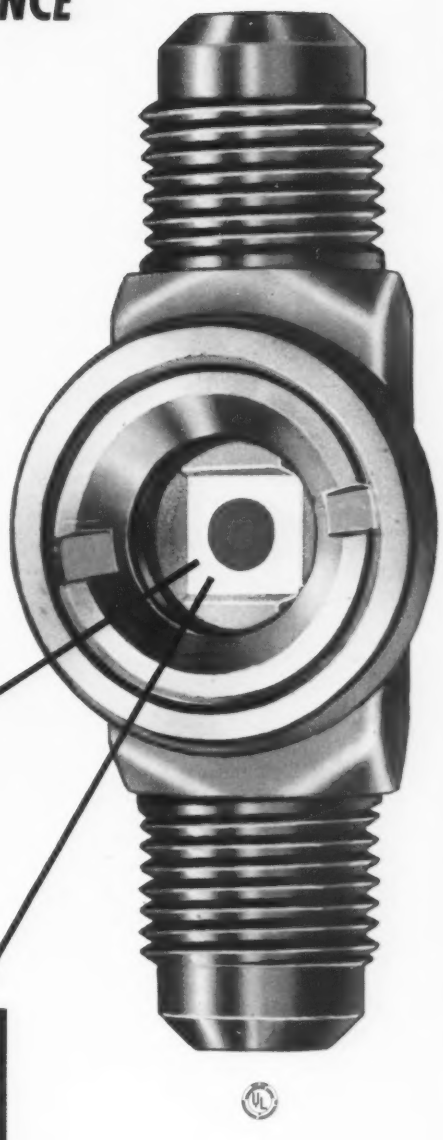
ATLANTA 1, GEORGIA

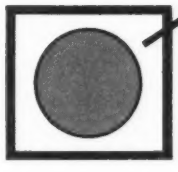
CHECK REFRIGERANT CONDITION AT A GLANCE WITH A NEW DUAL PURPOSE MUELLER BRASS CO.

Vuemaster®

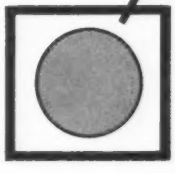
LIQUID-MOISTURE INDICATOR



This new indicator gives the same dependable, leak-proof performance that has made the Streamline single port liquid indicators famous, but has the added advantage of being a combination moisture and liquid indicator all in one compact unit. A color spot indicator in the new Vuemaster enables you to check refrigerant condition instantly. When the color spot is round and blue, the system is sufficiently charged and the refrigerant is in a normal, dry condition. The spot changes to pink when excessive moisture is present. If refrigerant level drops, the spot loses its round shape. Vuemasters are fabricated of sturdy, pressure-tight forged brass, triple-sealed against seepage and individually packaged in sturdy, dust-proof containers. For complete specifications, write Mueller Brass Co. today.



Round blue spot shows the system is full and dry.



Round pink spot shows that moisture is present.*

Color spot indicator loses its shape when refrigerant level drops.

*When the color spot is pink it's time to install a Drymaster Filter-Drier . . . avoid freeze-ups, acid, sludge and corrosion problems.

A heavy duty, safety-seal brass cap keeps the sight port clean and protects the unit from dirt and damage. The cap is knurled for easy tightening and removal by hand.

MUELLER BRASS CO. LIQUID INDICATORS TO FIT EVERY INSTALLATION REQUIREMENT AVAILABLE ONLY AT BETTER WHOLESALERS EVERYWHERE

Mueller Brass Co. Liquid Indicators are available with flare or solder-type connections in a complete range of sizes in straight-through, single port with extended ends and double port models.

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Drymaster®

THE PERFECTLY BALANCED FILTER-DRIER THAT REMOVES MOISTURE, ACID AND SLUDGE FROM REFRIGERATION SYSTEMS

DRYMASTER is the only Filter-Drier that gives you **GUARANTEED BALANCED PERFORMANCE** . . . matches drying capacity and filtering area to exactly meet the demands of every installation. The superb drying and filtering qualities are due to these outstanding design features:

DRYMASTER'S HI-FI FILTER BLOCK DESICCANT is a fully activated, pressure molded briquette. Effectively removes moisture from refrigerant lines as well as harmful acid, sludge and foreign particles.

DRYMASTER'S CENTER FILTER TUBE, over which is fitted a super-fine monel metal sleeve, is a combination that acts as a doubly effective safeguard against dirt and sludge; removes even micron-size foreign particles.

DRYMASTER'S INLET DISTRIBUTION DISC disperses refrigerant evenly throughout entire filter block desiccant. Combined area of openings in the perforated disc is carefully calculated to prevent pressure drop.

DRYMASTERS are available in 49 different sizes, with either male or female flare or solder-type end connections. Whichever style you use, you always get superb protection from acid, moisture and sludge . . . with Drymaster . . . the most perfectly balanced filter-drier you can buy.

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Once installed and loaded with Hi-Fi Filter Block Desiccant Briquettes, the new refillable, angle-type Drymaster Filter-Driers are in for the life of the system. Replacement of briquettes is fast and easy and you get new drier performance every time you re-charge. Available in 13 different sizes from 5 to 50 ton capacity.

THERE'S A SIZE AND TYPE OF MUELLER BRASS CO. FILTER-DRIER TO FIT EVERY REFRIGERATION REQUIREMENT

AVAILABLE ONLY AT BETTER WHOLESALERS EVERYWHERE

Write today for latest Drymaster handbook.

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(*Continued from page 87*)

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Wiremold Company, Hartford 10, Conn.

Valves. For fluid flow and condition control, these valves are covered in eight-page Bulletin 5911251, which details such design and selection factors as function, application and method of actuation. Subsequent pages give engineering data, characteristics, range specifications and illustrations of various types of valves: by-pass, relief, check, regulator, shutoff, measuring, sequence and special purpose.
United Aircraft Products, Inc., 1116 Bolander Ave., Dayton 8, Ohio.

Cooling Tower. Capacity tables in ton per cell for mechanical refrigeration service and gpm per cell for absorption refrigeration service for Series B and R Lo-Line cooling towers are presented in four-page Bulletin 51-902. Advantages cited for the towers include reduced weight, canted collecting pan, central depressed sump, glass fiber fanstack and fire-resistant casing.
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Guardflex Metal Hose Inc., 290 Broadway, Garden City Park, N. Y.

Industrial Insulations. Properties and specifications of a complete line of more than 30 heat and cold insulations for service from sub-zero to 1900 F are presented in a 24-page 1960 Catalog. Spun mineral wool, calcium silicate and 85% magnesia products in block, blanket, felt, fill, cement and pipe insulation forms are extensively described and illustrated. Thermal conductivities and tables of recommended thickness are given for each product for appropriate temperature ranges. A selection chart, indicating temperature range of all included types of material, is presented along with illustrations of typical installations in several fields.
Baldwin-Ehret-Hill, Inc., 500 Breunig Ave., Trenton 2, N. J.

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Anemostat Corporation of America, 10 E. 39th St., New York 16, N. Y.

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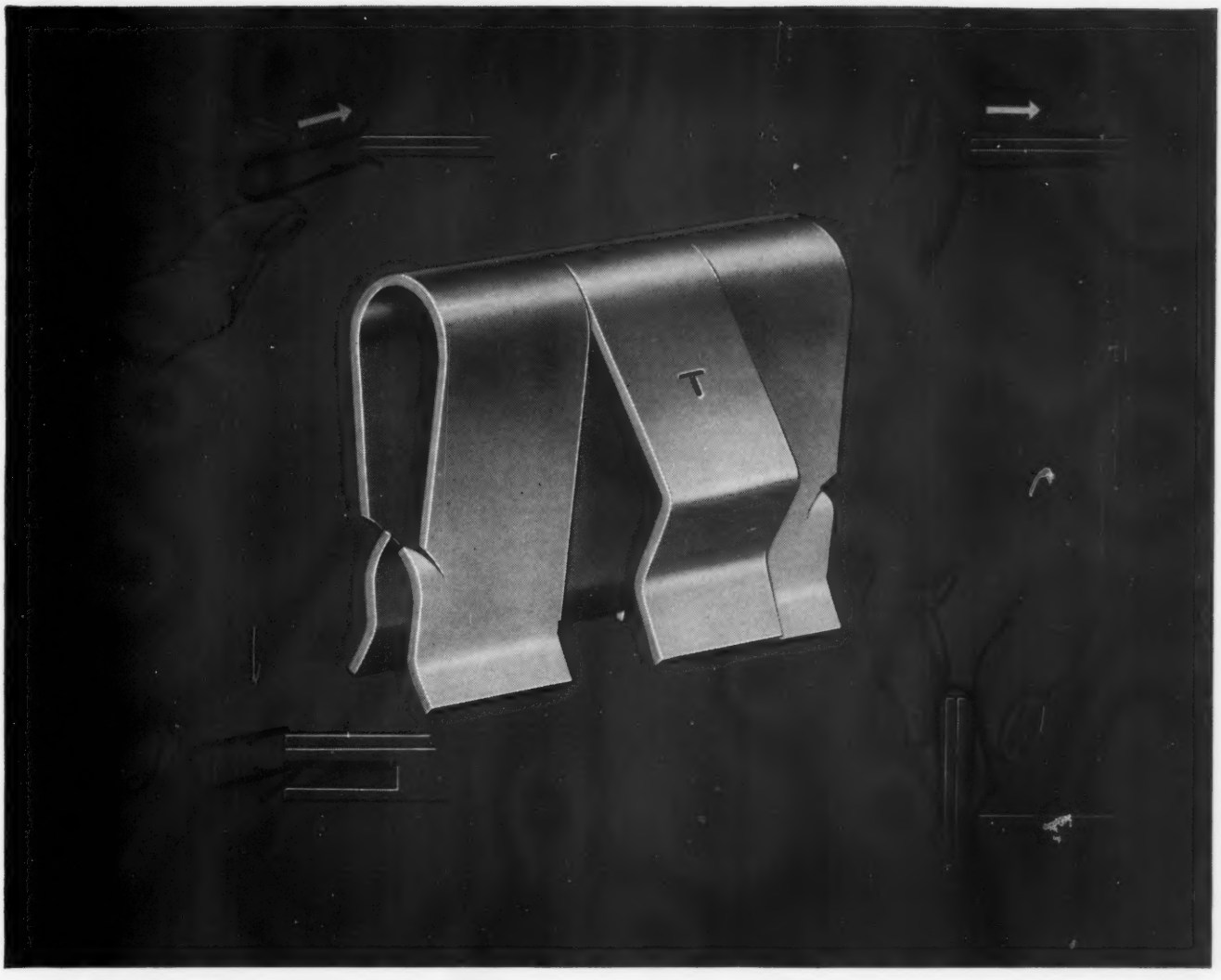
100% Molecular Sieve with Selective Filtration

Here's the complete capillary replacement assembly . . . KMP Moisture Magnet® Drier, correct size capillary, and strainer.

- **KMP HIGH SIDE KAP-KIT IS THE ONLY HIGH SIDE REFRIGERATION DRIER**
  Molecular sieves, with their high temperature moisture holding qualities, permit the use of a drier for the first time on the high side of the refrigeration system with maximum efficiency.
- **MOLECULAR SIEVES ARE SELECTIVE**
  They have selective absorbing qualities . . . will not adsorb oil additives (TCP) thereby permitting bearing wear. Adsorb only moisture and acid.
- **HAS LARGE SCREENING AREAS**
  Screen out sludge, dirt and foreign particles.
- **HANDLES 48.5 DROPS OF WATER UNDER HEAVIEST LOADED CONDITIONS**
- **THOROUGHLY DEHYDRATED AND SEALED AT FACTORY**
- **KAP-KITS ARE AVAILABLE IN 4 SIZES TO HANDLE ALL REQUIREMENTS UP TO ½ HP**
- **KAP-KITS ARE AVAILABLE WITH EITHER ¼" OR ⅜" FLARE CONNECTIONS**

WRITE Kenmore for the names of jobbers in your territory.

KMP
KENMORE MACHINE PRODUCTS, INC.
LYONS, NEW YORK
Driers • Accumulators • Accumulator Driers • Strainers • Capillary Assemblies
IN CANADA: Kenmore Machine Products (Canada), Limited, Grimsby, Ontario



Another SPEED NUT brand fastener...

Just a thumb-push...and steel teeth fasten steel with Tinnerman "U" CLIPS

Twin-action gives this Tinnerman "U" SPEED CLIP® extra holding power in fastening together two sheets of metal, plastic or wood without screws... the heat-treated spring steel tension in the "U" exerts a clamping action... the tiny upset barbs bite in and hold on for keeps.

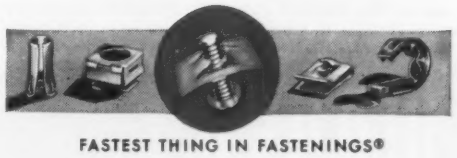
Cost of assembly is substantially reduced when you use Tinnerman "U" Clips for fastening... extra assembly steps are eliminated... no special tools or skills are required... and Tinnerman "U" Clips hold for good!

SPEED NUT Brand "U" Clips are easy to apply ...merely thumb-push them over the edges of the panels. A variety of Tinnerman fastener features can also be incorporated with the "U" Clip principle...cable clips, protruding legs to hold glass panels in lighting fixtures, and others.

Call your Tinnerman SPEED NUT representative today... if he's not listed in your "Yellow Pages" Directory under "Fasteners", write direct.

TINNERMAN PRODUCTS, INC.
Dept. 12 • P. O. Box 6688 • Cleveland 1, Ohio

TINNERMAN
Speed Nuts®



FASTEST THING IN FASTENINGS®

CANADA: Dominion Fasteners Ltd., Hamilton, Ontario. GREAT BRITAIN: Simmonds Aerocessories Ltd., Treforest, Wales. FRANCE: Simmonds S. A., 3 rue Salomon de Rothschild, Suresnes (Seine). GERMANY: Mecano-Bundy GmbH, Heidelberg.

sions of the motors are described and applications for motors in ratings of one through 20 millihp are listed. A tentative selection guide is included, together with charts indicating relative sound level, sound frequency, wear-friction and temperature effect on starting.
General Electric Company, Schenectady 5, N. Y.

Flange Blocks. Added to this manufacturer's line of 900 Series Tapered Roller Pillow Blocks are Tapered Roller Bearing Flange Blocks, available in shaft sizes 1-3/16 and 2-15/16 in. All units are equipped with tapered roller bearings, eccentric locking collars, malleable housings and Centrap grease seals. Twenty-page Catalog BU-103 contains complete specifications, comparison charts and load rating charts.
Browning Manufacturing Company, Maysville, Ky.

Dehumidifying Systems. Descriptive of Model C Kathabar air conditioning and drying systems is 16-page Bulletin K-160, which also covers climate control rooms. Dehumidifiers included are used to stop condensation, speed drying and other processing operations, obtain sub-freezing dew points and make air sterile to hospital standards. Climate control rooms are prefabricated standard test rooms designed to establish and produce almost any temperature, humidity and bacteria-controlled conditions desired for product testing.
Surface Combustion Div, Midland-Ross Corporation, 2375 Dorr St., Toledo 1, Ohio.

Water Cooling Coil Catalog. For fast selection of all types of water cooling coils, 60-page Catalog 406 introduces a new direct selection method and presents an extensive compilation of data to meet most required specifications. Various types of coils are described and explained in detail with circuiting illustrations and application recommendations. General coil considerations involved in selection for any requirement and design load are explained in detail, assisted by psychrometic charts and curves.
McQuay, Inc., 1600 Broadway St., N.E., Minneapolis 13, Minn.

Fabricated Silicone Rubber. For the engineer, six-page Bulletin HTM-2-1-60 describes seals for the aircraft, electronic and appliance industries; precision-molded parts; extruded parts; and sheet and die cuts available in fabricated silicone rubber. From this booklet, it is possible to select and specify the correct silicone rubber part to meet typical application problems. Also included is a partial listing of special purpose compounds to meet specific requirements.
Haveg Industries, Inc., Taunton Div, 336 Weir St., Taunton, Mass.

Property Variations of Thermostat Metal. How thermostat metal elements can be stacked to satisfy performance specifications in space that prohibits use of a single element with sufficient material volume is the subject of Flyer TRU-11. Multiple element assemblies in series, parallel and parallel series are discussed. Rules for determining thermal deflection, mechanical deflection and force of each type of assembly, as compared to the properties of the single elements that make up the assembly, are given.
Metals & Controls Div, Texas Instruments, Inc., 34 Forest St., Attleboro, Mass.

Valves. Operating specifications, characteristics, sizes, ratings and illustrations of this manufacturer's valve lines are presented in tabular form in 16-page Catalog 10-A. Equipment described includes: bronze, iron and forged steel gate valves; bronze and

testing set deluxe—
Instrument beauty! Not just outward beauty. Beauty that runs deep. The beauty of quality and precision...all the way through.
Polished brass cases with sparkling bevelled glass crystals held in knurled threaded rings that give ready access to the "Recalibrator"...so vital in a testing instrument. Two scales in color marked in corresponding temperatures of R-12 and -22. Precision movements that deliver the remarkable accuracy of plus or minus 1% of dial reading.
Compound gauge now has longer (0-80 lbs.) retard scale—and increased maximum reading...to 250 lbs. Range of pressure gauge also increased ...to 400 lbs.
So much more for so little more! Own them proudly. Use them proudly. To fully appreciate them, see them.
—at your wholesaler
MARSH INSTRUMENT COMPANY, Division of Colorado Oil and Gas Corporation, Dept. 32 Skokie, Ill. • Marsh Instrument and Valve Co. (Canada) Ltd., 8407 103rd St., Edmonton, Alberta • Houston Branch Plant: 1121 Rothwell St., Sect. 15, Houston, Texas
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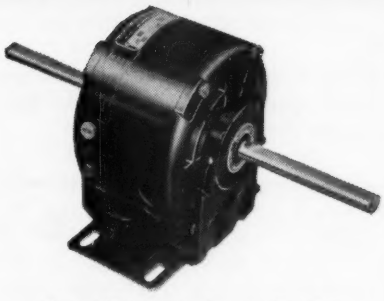
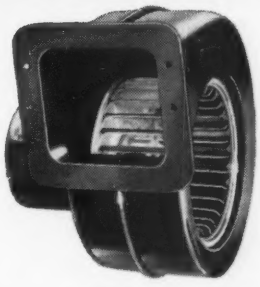
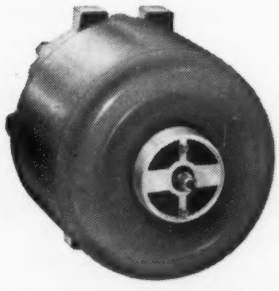


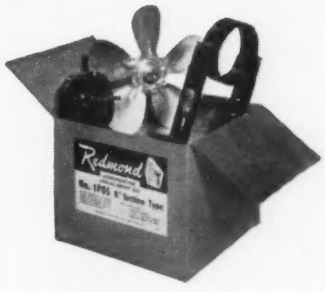
air conditioning replacement motor



for applications through 325 cfm



condenser fan motor



"all in one" replacement kit

Redmond offers you both a complete line of fhp electric motors, blowers, kits, and accessories, and the name that is known nationally as "The BIG Name in Small Motors."

As a Redmond Distributor you profit because of the products available to you, and you increase your sales because Redmond gives you without charge the most complete line of sales and merchandising aids available, backed up with a complete advertising program. It will pay you to take a minute to find out if the Redmond Distributorship in your area is still available. Just fill in the coupon below.

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iron globe and angle valves; bronze and iron check valves; asbestos packed iron cocks; bar stock valves, valve parts; steel and forged valve accessories; and cast steel valves.
American Chain & Cable Company, Inc., 929 Connecticut Ave., Bridgeport 2, Conn.

Fractional Horsepower Motors. Twelve-page Bulletin GEA-6424A discusses benefits and features of the complete line of fractional horsepower Form G general purpose motors. Capacitor-start, split-phase, permanent-split capacitor, shaded-pole and polyphase motors are included. Sixteen different kinds of motors for various applications are shown in Nema frame sizes 48 through 56.
General Electric Company, Schenectady 5, N. Y.

Corrosion Resistance Rating Guide. Listing the relative ability of metals, plastics and synthetic rubbers used in manufacture of Flo-Ball Valves to resist corrosive effects of 390 different fluids encountered in industry is an eight-page bulletin. An easy-to-read tabulation permits rapid estimate of effect of the fluids, alphabetically arranged, on selected materials of construction. Metals covered are aluminum, carbon steel, semi-steel and 316 stainless steel; synthetic rubbers are Buna N, Neoprene and Viton A; plastics are Teflon, Nylon and Kel-F. Physical characteristics and temperature range of the plastics and synthetic rubbers are provided together with chemical composition of the metals.
Hydromatics, Inc., 70 Okner Pkwy., Livingston, N. J.

Plant Equipment. Directed towards those interested in selection and supervision of plant equipment, eight-page Bulletin 223, "Products for the Plant," covers standard reciprocating, axial flow and centrifugal air compressors; centrifugal pumps; steam condensers; steam-jet ejectors; vacuum pumps; air hoists; and air and electric tools. Representative machines in each product line are illustrated and design features noted. Size and capacity ranges and recommended applications are also given.
Ingersoll-Rand Company, 11 Broadway, New York 4, N. Y.

Domestic Power Gas Burner. Designed for conversion of down draft and horizontal type heating units or units that do not have sufficient combustion area to fire necessary input with an atmospheric burner, this unit is the subject of Flyer 401. Specifications and major features are listed.
Liberty Combustion Corporation. P. O. Box, 300, Syracuse, N. Y.

Fluid Filter Elements. Four-page Bulletin 142 covers typical fluids and systems that can use Poromesh and Micromesh wire cloth filters. Details of design features, environments, construction, performance and metals for these filters are also discussed. Illustrations show typical filter elements, wire cloth filter element construction and manufacturing techniques and facilities.
Bendix Filter Div, Bendix Aviation Corporation, 434 W. 12 Mile Rd., Madison Heights, Wisc.

Roof Exhausters. Engineering data on Key Line Axial Power Roof Exhausters is contained in four-page Bulletin 60-AK. Key Line is a new exhauster design in which the motor and drive assembly are mounted in a separate housing parallel to the blade, removing the motor from the air stream and effecting a reduction in overall height. Listed in the bulletin are air moving capacities for 71 different axial models under static pressure conditions ranging from zero

GET ACCURATE FLOODED SYSTEMS CONTROL

with this level regulator

A SIMPLE CONTROL IS THE BEST CONTROL

PHILLIPS
FLOAT CONTROLS

- **Proportioning action for smooth feed at all capacities**
- **Tight Closing with Teflon seat discs**
- **Self actuation—no electrical or pneumatic connections needed**
- **Visible liquid level through exclusive "Level Eyes"**
- **Adjustable level achieves maximum capacity with minimum charge**

IN ADDITION — Phillips pilot operated valves are available for all common refrigerants, down to —50° F. Operates with as low as 2 PSI pressure drop and up to 250 PSI with selected springs. Line sizes ½ inch to 4 inches with steel or copper connections.

Solve your flooded system design and application jobs by consulting Phillips. Our firm of engineers have specialized in level control, liquid-vapor separation, liquid circulation and return systems for over 28 years.

H. A. PHILLIPS & CO.
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3255 W. Carroll Ave.
Chicago 24, Illinois

ARCHITECT: Curtis E. Haley, Coral Gables, Fla.

CONSULTING ENGINEERS: J. E. Curley & Associates, Coral Gables, Fla.

THERMAL AGENT: A. C. Dean Co., Miami, Fla.

COMFORT AID TO EDUCATION

Vertical Multizone Unit

Thermal Units Air-Condition Huge Vocational School

The Lindsey Hopkins Vocational School in Miami, Florida, is believed to be the nation's largest and most successful adult vocational school with an enrollment of about 39,000. The building pictured above houses most of the classes which meet during the daytime and evening. Fifteen of Thermal Engineering's horizontal central plant type and multizone air conditioners maintain the comfort level in these busy classrooms.

From Presque Isle, Maine to Miami, Florida, and across the nation to the Pacific, Thermal Engineering's equipment is meeting the demand for year 'round comfort in all types of structures, under many varying climatic conditions. Its performance and quality assure architects and engineers that this equipment can be specified with confidence.

For finer air conditioning and ventilating equipment for every climate to fit all architectural requirements, you can specify Thermal. The Thermal line includes central plant and multizone conditioners, sprayed coil units, heating and ventilating units, heating and cooling coils and air-cooled condensers. We will be glad to furnish you our complete catalog.

Quality Products Since 1945

THERMAL ENGINEERING CORPORATION

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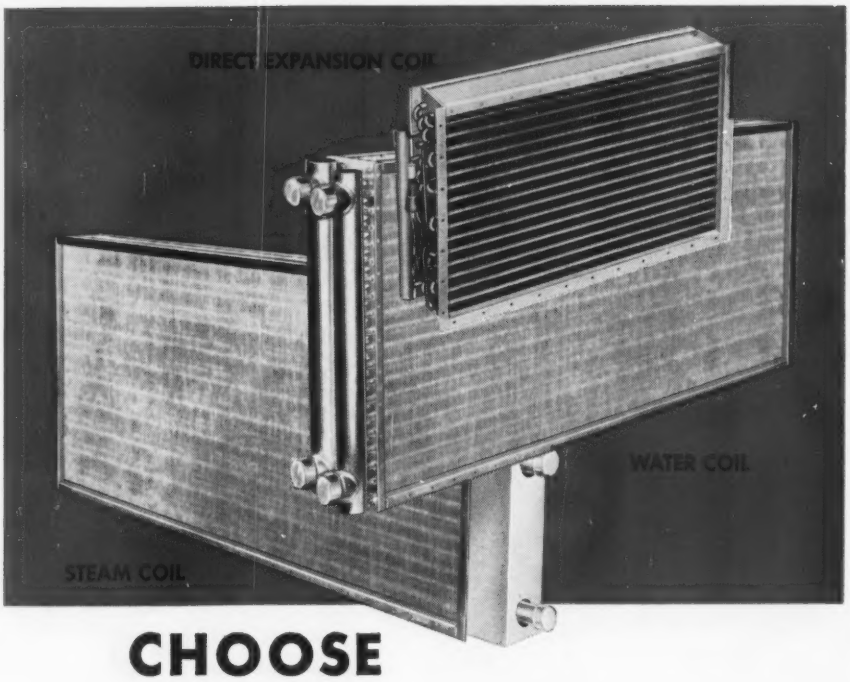
HOUSTON 19, TEXAS

AGENTS IN PRINCIPAL CITIES



CHOOSE BOHN KNOWN-CAPACITY COILS

ALL BOHN COILS are ruggedly built...

- Die-formed plate-type aluminum fins... from 4 to 14 per inch...with self-spacing collars completely covering the tubes. Permanent, tight, metal-to-metal fin-tube bond.
- Heavy-gauge casings die-formed from galvanized steel.
- Headers of heavy-wall seamless copper tube with heavy die-formed end caps. High pressure tested at 320 psig. minimum air pressure under warm water.
- Tested and rated according to ASRE-ASHAE standard 33-58.

IN ADDITION...

DIRECT EXPANSION COIL — Type DE, insures equal distribution of refrigerant with brass pressure-type distributors;

WATER COIL — in Types WH, WF, and WD, is drainable in every type;

STEAM COIL — in Types S, NFS, and NFO, has condensing tubes pitched in casing a minimum of ⅛" per foot of tube length, as well as orificed steam supply tubes, and coil tubes floating free within coil casing to prevent stress and strain on tubes and joints... maximum operating pressure 200 psig. at 400° F.

We have some territories still open for Manufacturers Representatives who are active in the heating and air conditioning fields. Write today to Sales Manager, Heating and Cooling Coil Department, at the address below.

BOHN *Buy the known line... the BOHN line*

Aluminum & Brass Corporation

Danville Division • Danville, Illinois

to ¾-in. sp. Also included are dimensional and curb cap drawings, electrical characteristics and optional accessories available.
Jenn-Air Products Company, Inc., 1102 Stadium Drive, Indianapolis 7, Indiana.

Panelcoil. Examples given in Bulletin M-9 show heating and cooling of many types of tanks, troughs, mixers and air duct systems using this product. Also shown are applications where Panelcoil has become part of the equipment itself, as in a percolator for a brew kettle, radiant shield for a high temperature furnace and an open top-mixing tank.
Dean Products, Inc., 1048 Dean St., Brooklyn, N. Y.

Blowers. Each blower and wheel described in 12-page Bulletin LAD866 is detailed with cross-reference to the manufacturer's engineering catalog. Series A and 2-A blower assemblies, Budget Blower units and Econopak blower units are listed, together with such parts as pulleys, bearing brackets, bearings and pillow blocks. In another section, various types of wheels now being produced are described. These include large diam riveted, single and double inlet weld, A series and DD Preslok wheels.
Lau Blower Company, Blower Div, 2027 Home Ave., Dayton 7, Ohio.

Rubber Expansion Joints. Comprising this line are three major types for pressure, pressure-vacuum and vacuum applications. Items are generally furnished in either standard spool or rectangular styles, both of which are pictured in the four-page bulletin descriptive of this product. Discussed are such topics as materials and their properties, flexibility, flanges, retaining rings, control rods and service ranges.
Mercer Rubber Company, Hamilton Square, N. J.

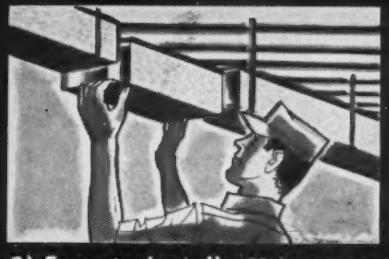
Sliding Gate Regulators. Flyer JNP-5 describes sliding gate pressure regulators now available in cast steel. Used on steam, water, air, oil, gas or chemicals wherever high pressures are present or larger pressure drops are needed, units are suitable for steam pressures to 300 psi and temperatures to 600 F, and will handle pressure drops up to 250 psi. Features are described, a cutaway drawing is shown and sizing charts, flow curve, sample specifications and engineering information are presented.
OPW-Jordan Corporation, 6013 Wiehe Rd., Cincinnati 13, Ohio.

7 ways AIRCOUSTAT® can save you time and money

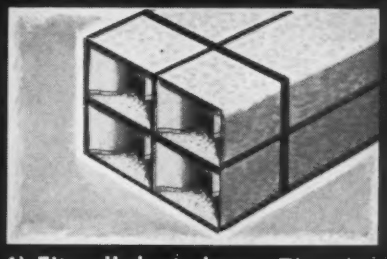
Sound Traps . . . with Guaranteed Results

1) Easy to select—Just 3 steps to specify proper model. Save time, avoid errors.

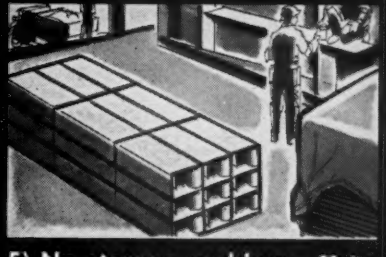
2) Easy to handle—No riggers or special equipment needed. Large units composed at job site.



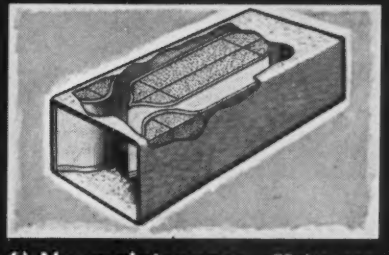
3) Easy to install—Units are installed the same as ductwork. Units have 2" extensions.



4) Fits all duct sizes—Big units are easily assembled from small Aircoustat units.



5) No storage problem—Units are delivered right to the job site, ready to install.



6) No maintenance—Units are fire-resistant, dust-proof and built to last a lifetime.

7) Guaranteed results—Solves every noise reduction problem. Units are completely reliable.

Pre-engineered by Koppers to eliminate guesswork, unnecessary calculations and difficult installations, AIRCOUSTAT Sound Traps guarantee trouble-free silencing of all duct-transmitted noise . . . at a savings in time and money to you.

AIRCOUSTAT selection is quick, simple and reliable. A choice of over 60 stock models, fabricated in 6 lengths, solves every noise reduction problem. AIRCOUSTAT is built to give a lifetime of maintenance-free service.

Write today for your copy of the AIRCOUSTAT Selection Manual, a quick guide to the right unit or combination of AIRCOUSTAT units to eliminate duct-transmitted noise in all air handling systems. Write KOPPERS COMPANY, INC., Sound Control Department, 3505 Scott Street, Baltimore 3, Maryland.

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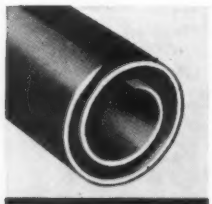
SOUND CONTROL

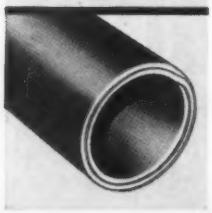
METAL PRODUCTS DIVISION

Engineered **Products Sold with** ***Service***

There's almost no limit to the things Bundy can mass-fabricate



Bundyweld is the only tubing double-walled from a single copper-plated *steel* strip, metallurgically bonded through 360° of wall contact for amazing strength, versatility.



Bundyweld is lightweight, uniformly smooth, easily fabricated. It's remarkably resistant to vibration fatigue; has unusually high bursting strength. Sizes up to ⅝" O.D.

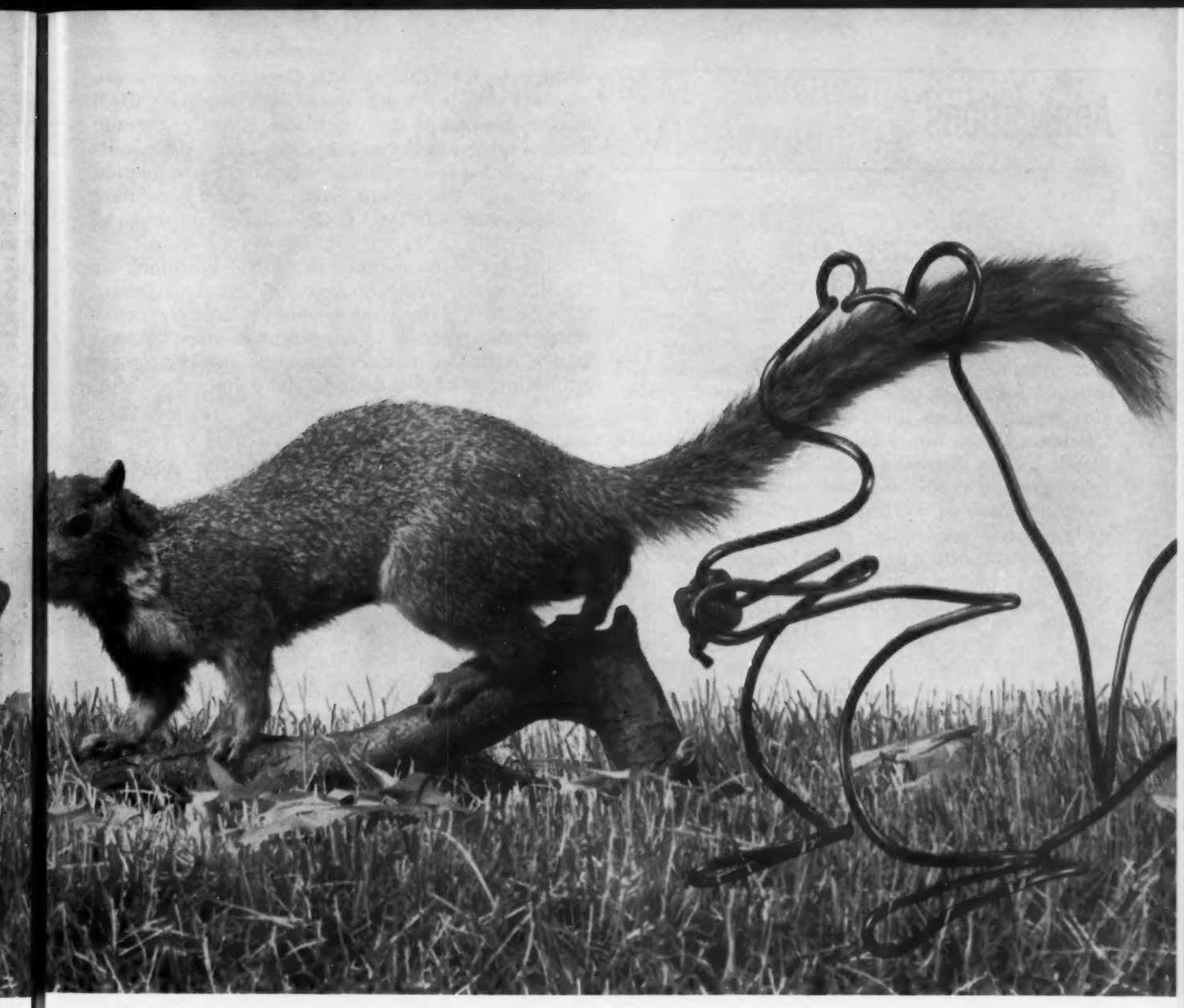
Maybe your tubing problems don't run to animal shapes, but it's likely that you can benefit from Bundy's experience in mass-fabricating complex tubing parts. Here's why:

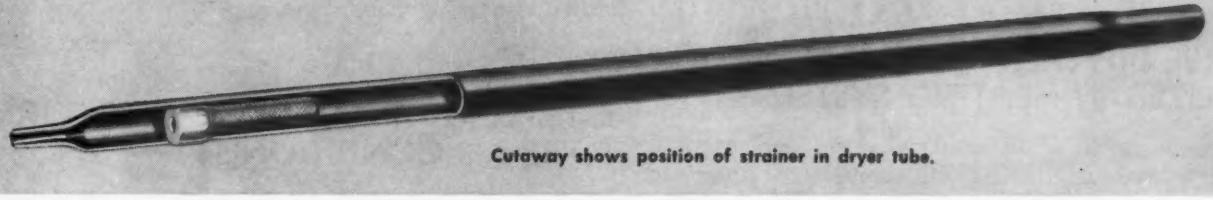
Precision bending: Bundy-developed machines turn out parts to exacting customer specifications . . . *with mass-fabricating savings.*

Great strength: Your component will be fabricated from Bundyweld®, the copper-brazed steel tubing that's *double-walled* from a single steel strip. Bundyweld's long history of leakproof performance has made it the safety standard of the refrigeration industry.

Expert design service: You can call on our engineering staff at any time to help with the design of your product. We may be able to point out short cuts that save you money without compromising engineering standards. Covered by Government Spec. MIL-T-3520, Type III.

Next time you have a tubing problem, better call Bundy *first.* Phone, write or call Bundy Tubing Company, Detroit 14, Michigan.





Cutaway shows position of strainer in dryer tube.

"11 inches of life insurance" . . . that's how Hotpoint describes this refrigeration dryer tube. Filled with synthetic zeolite, it absorbs the slightest trace of moisture to protect the refrigeration system from failure. The tube is made from 3/8" O.D. x .028 Bundyweld. One end is reduced slightly for silver soldering, while the other is reduced to .080 I.D. in less than 5/8".

There's no substitute for the original

BUNDYWELD® TUBING

WORLD'S LARGEST PRODUCER OF SMALL-DIAMETER TUBING • AFFILIATED PLANTS IN AUSTRALIA, BRAZIL, ENGLAND, FRANCE, GERMANY, AND ITALY

BUNDY TUBING COMPANY • DETROIT 14, MICH. • WINCHESTER, KY. • HOMETOWN, PA.

Applications

CONTROL OF COOLANT INCREASES PLASTICS PRODUCTION

If machined at a low enough temperature, Tenite becomes brittle; machining at high temperatures permits softening, with resultant loss of precision and eventual fouling of tools. In an application at Miggins Screw Products, Inc., Brewster, N. Y., the close tolerances which are required (±0.002 on the OD) dictate a high degree of machining stability.

To increase production and improve quality, the company installed a Heat-X cast aluminum cooler with separate condensing unit. The coolant, water with a rust inhibiting agent added, is maintained at a constant temperature of 58 F. Production rate since installation has risen from 350 to 1110 pieces daily.

DOUBLE DUCT SYSTEM CONDITIONS OFFICE BUILDING

Air conditioning in the ten-story Tidewater Oil Company headquarters building in Los Angeles features two Recold multizone units on each of the first six floors. One unit serves the east and one the west wing of each floor. Hot and cold ducts of the chilled and hot water, double-duct system are tapped off at each unit and run down each main corridor. Individual zones of the building are tapped and controlled off the hot and cold ducts in the corridor areas.

Two additional units serve special areas of the building; one air conditioning the IBM room is controlled separately so that it may be in operation 24 hr a day. The second unit serves the mezzanine and storage rooms.

THREE DIFFERENT METHODS UTILIZED IN HEATING SYSTEM

Extensive areas of exposed windows and exposed concrete slab in the recently completed American Society for Metals headquarters office building in Cleveland, and a desire to provide for future cooling resulted in design of a heating system utilizing air handling units, radiant floor panels and fin tube perimeter radiation. Spanned by a lattice 274 ft diam and 103 ft high, the building is semicircular and contains approximately 50,000 sq ft of floor area on three levels. Construction is reinforced concrete floor slabs on exposed steel columns, with a total of 23,000 sq ft of window walls.

To compensate for these conditions and provide satisfactory heating, fin tube radiation was installed on the exterior walls, a radiant floor panel system on the top floor and a multi-zoned air handling system throughout the building. All three components are supplied with hot water heated by a single 3,800,000 Btu/hr boiler. Water circulates directly through Chase copper tube Type L headers, additionally heating, through a converter, the water-antifreeze solution used to heat the radiant floor panels, by circulating through ½-in. soft Type L Chase tube with soldered fittings.

Individual room thermostats control the zoned air handling units. Temperature of the circulating water is adjusted by the indoor-outdoor control, hotter water being pumped as temperatures drop. Radiant heat is controlled to cease operation at 60 F, converter heating at 65 F and air handling units at 70 F.

SYSTEM MELTS SNOW ON SIDEWALKS OF TELEPHONE COMPANY BUILDING

Three sidewalks skirting Southern New England Telephone Company's new General Office Building in New Haven, Conn., have been equipped with an automatic snow melting system to keep pavement clear of ice and snow.

Covering an area of 9100 sq ft, including entrances to the building, ¾-in. diam snow melting grids were

laid on 12-in. centers, then enclosed in five in. of concrete, three in. above pipe and one in. below. The system was hydrostatically tested six hr under 125 psi. In operation, it will carry a mixture of ethylene glycol and hot water. A. M. Byers Company furnished the wrought iron pipe.

BI-LEVEL RAILROAD COMMUTER CARS TO BE AIR CONDITIONED

All-electric heating systems to be installed on 116 new commuter cars being built for Chicago & North Western Railway operate on 480-volt, 60-cycle, three-phase current, transmitted via train lines from a power plant in the locomotive. Floor heat is to be provided by strip heaters along each side wall at the lower-level floor line. Overhead heat is provided by units in the main air conditioning ducts. With an outside air temperature of −10 F, the system is expected to maintain a min interior temperature of 60 F.

Air conditioning will be provided by two eight-ton Trane self-contained units in the ceiling, each unit supplying half the car. Unit capacity is rated at 96,000 Btu/hr with a total air supply of 2400 cfm,

HENRY VALVE CO.

CONTROLLING FLOW SINCE 1914

DEMAND IS GREAT... EVERYONE IS BUYING THESE EXTRA VALUE PRODUCTS

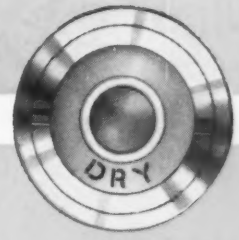
"DRI-VUE" Moisture-Liquid Indicators

"DRI-COR" Filter-Driers Molded Core

"GOLDEN BANTAM" Diaphragm Packless Valves

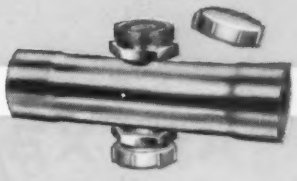
"DRI-VUE" INDICATOR PORT

Actually Spells "WET" or "DRY" with element Color Variation—Largest Visible Element Area.



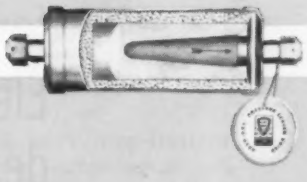
"DRI-VUE" INDICATORS

Double Port Moisture-Liquid Indicators, Large O.D.S. Sizes. Triple Sealed Ports.



"DRI-COR" FILTER-DRIERS

Two Stage Drying; Molded Core and Granular Desiccant. Abso-dry Processed.

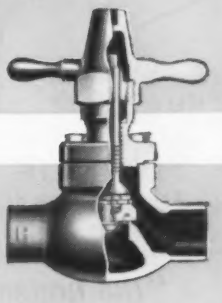


"DRI-COR" Cartridge DRIERS

Molded Filter Core and Granular Desiccant. Split Second Cartridge Installation.

SHUT-OFF VALVES

Packless and Packed with Flanged and Integral Connections. Wide Range of Sizes and Types.



Only Henry offers you this complete variety of types and sizes, from ¼" flare packless to 4⅛" O.D.S. packed Wing Cap valves, from 1 ton sealed type to 165 ton cartridge type filter-driers and ¼" flare single port to 2⅛" O.D.S. double port moisture indicators.

HENRY VALVE COMPANY

For Refrigeration, Air Conditioning and Industrial Applications

MELROSE PARK, ILLINOIS, U.S.A. CABLE: HEVALCO, MELROSE PARK, ILL.

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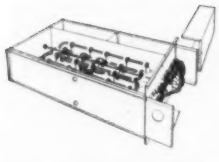

Heat Pump Supplemental Heat Package Unit with controls and shell.

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TECUMSEH, MICHIGAN

MANUFACTURED AND DISTRIBUTED IN CANADA BY CRONAME (CANADA) LTD., WATERLOO, QUEBEC

25% outside air, based on outside temperature of 100 F, 50% relative humidity. One duct on each side of the car, built into the upper-level floors, and a single center line ceiling duct will comprise the duct system.

Units, the same type as others developed by Trane for Chicago & North Western bi-level intercity cars in 1958, each contain a three-cylinder accessible hermetic industrial type compressor, split coil evaporator and fan, condenser coil and fan and a motor starter panel. Each cooling unit contains an evaporator coil which is split into two equal sections – one upper and one lower. To control refrigerant flow, each section is provided with a thermostatic expansion and solenoid liquid valve. Each solenoid liquid valve is controlled by an individual relay which is, in turn, controlled by a two-step thermostat. As car temperature increases (above 79 F), the first stage of the thermostat will close, energizing the first relay and opening the valve on the upper section of the split coil. Liquid refrigerant will then flow through the coil and cooling will take place. If car temperature continues to increase, the second stage will close, energizing the second relay and opening the solenoid valve on the lower coil section for additional cooling capacity.

SUB-ZERO WAREHOUSE EXPANDS PACKING COMPANY FACILITIES

Construction of a 20,000 sq ft sub-zero storage warehouse has expanded the facilities of Western Turkey Packing Company, Dinuba, Calif. Of 20-ft concrete tilt-up panel construction with eight-in. insulation on walls and ceiling, the building has a roof of one-half-in. ply-scord covered with glass fiber roofing. Featured in the floor is perimeter insulation, with the major part of the building protected from freeze heaving by a network of piping in the fill. Oil at 70 F is circulated through this piping.

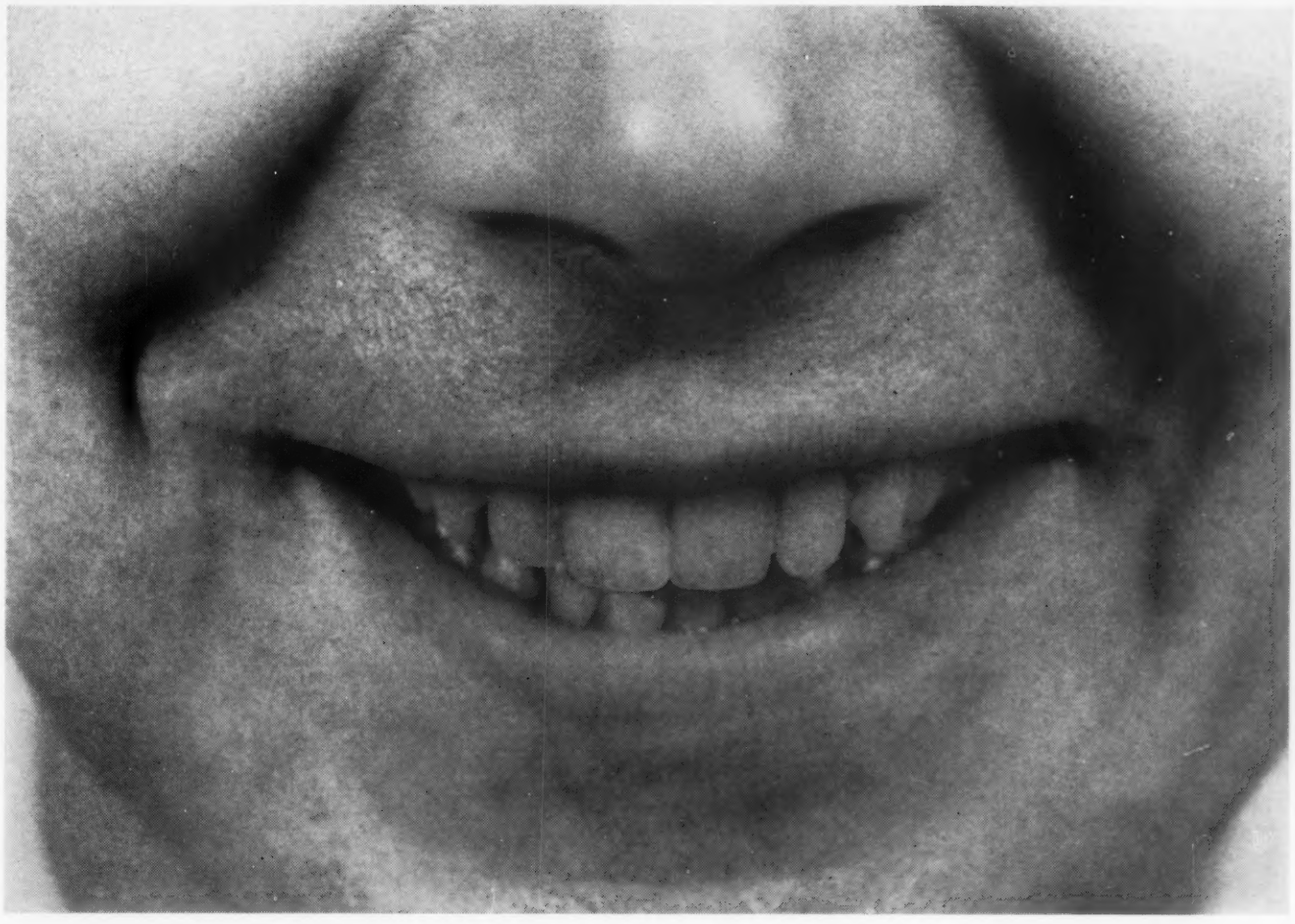
Four Kohlenberger FCM 1400 floor type air unit coolers are located above two large storage rooms, maintaining their temperature at –10 F. Two Krakice Makers located inside a weather penthouse supply ice for poultry chilling to an ice storage bin with a 60-ton holding capacity. Other Kohlenberger equipment incorporated in the building includes: OLS 4-cyl 10 x 7½ 60 hp Booster, OAS 4-cyl 7½ x 7½ 100 hp High Stage, KE 100 Evaporative Condenser, Air Cooled Interstage Desuperheater and Sub-floor Heat Exchanger.

IN JUNE

Economics of Air-Cleaning and Odor Removal

We Propose a New Humidity Standard

This Coil-Rating Factor Makes Heat Exchangers Comparable

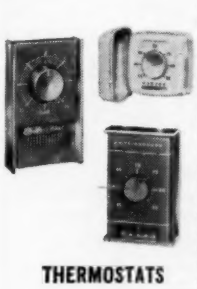


Customer satisfaction is the EXTRA factor in White-Rodgers controls

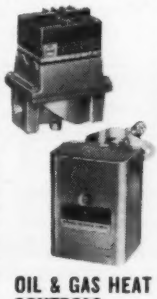
At White-Rodgers, controls are our only business . . . precision controls with an extra quality factor built in to assure accurate performance throughout the life of your appliances and equipment.

The result is more customer satisfaction, and less trouble for you, your dealers and your service organization. Your reputation is protected, your servicing costs are lower, and warranty-period problems become a thing of the past.

If this is your goal, call in White-Rodgers engineers to help solve your temperature control problems.



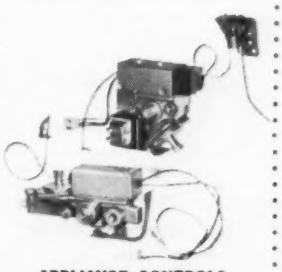
THERMOSTATS



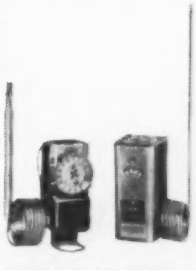
OIL & GAS HEAT CONTROLS

WARM AIR & HOT WATER CONTROLS

ZONE CONTROLS



APPLIANCE CONTROLS



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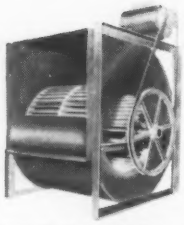
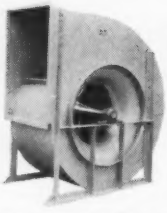
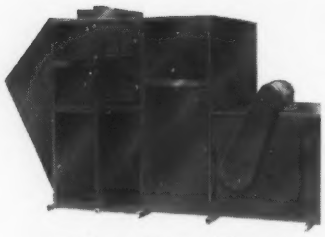


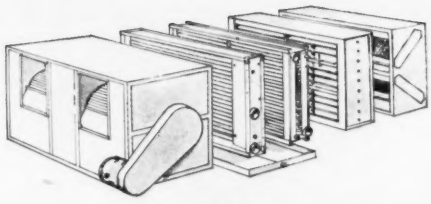
Standard Duty Blower



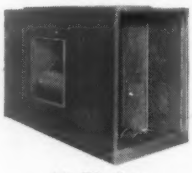
Heavy Duty Blower



Multizone Air Conditioner



Climate Maker



Air Washer Evaporative Coolers

Rotors and Scrolls

SEEING IS BELIEVING

Investigate Complete Lines of Quality Air Conditioning Equipment for the Specifying Engineer

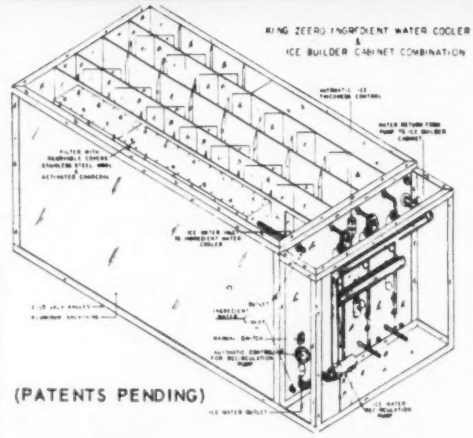
4 COMPLETE LINES

I—A line of climate makers with complete engineering data, details of construction and positive performance. Airfan uses Aerofin coils for heating and cooling. Wide selection—12 sizes—capacity from 1500 to 35,000 cfm—up to 6" S.P.
Gas Fired Multizone Units for heating and Aerofin DX coils for cooling—12 sizes —capacity range 2500 to 35,000 cfm.
II—Heavy duty blowers, both forward and backward curved—Class I & II—Size #2 to #11. All laboratory tested.
STANDARD DUTY BLOWERS—Wheels of center hub construction—blades riveted, for heating, ventilating and air conditioning.
III—Nine standard models of air washer evaporative coolers, the largest manufacturer in the field of slinger coolers.
Capacity range from 2500 to 31,000 cfm.
IV—Rotors and scrolls to OEM accounts who manufacture evaporative condensors, air handling units, and air conditioning equipment. Class I wheels are available in standard, hot dipped galvanized, stainless steel and aluminum. Wide selection—Diameters 10, 12, 15, 17, 18, 19, 21, 22, 24, 27, and 30.

COMPLETE CATALOGS—DATA ON REQUEST.
TERRITORIES OPEN FOR QUALIFIED AGENTS

AIRFAN ENGINEERING COMPANY
7401 TELEGRAPH ROAD, RA 3-3354, LOS ANGELES 22, CALIF.

For Ideal Filtered Ingredient Water at Low Cost



(PATENTS PENDING)

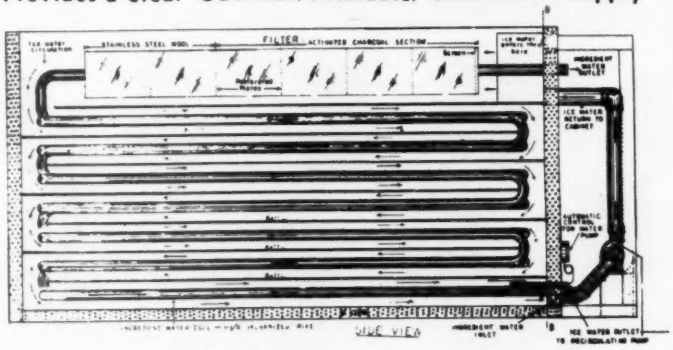
- Cools water 34 degrees Fahrenheit.
- Filter removes all silt, algae and chlorine from city or well water supply.
- Pure water is chilled by ice water -- *prevents freeze-ups.*
- The ideal water for ingredient and wash water applications -- food processing needs, butter or cheese wash, dough water, poultry or produce chilling.

Available in Cabinet or Vertical Styles.

Write for Bulletin PWC 59.

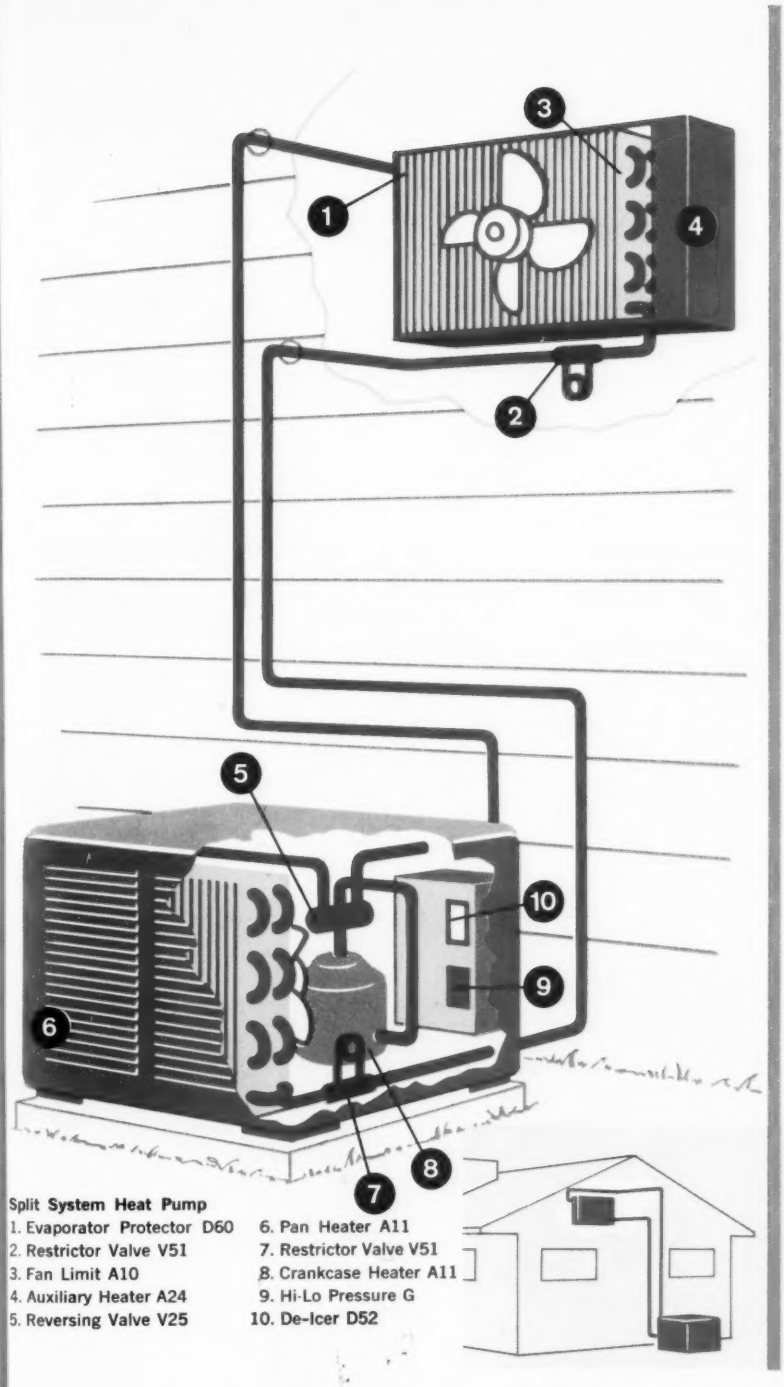
Choose "King Zeero's" NEW PURE WATER COOLER

Provides a Clear Odorless, Palatable, Cold Water Supply



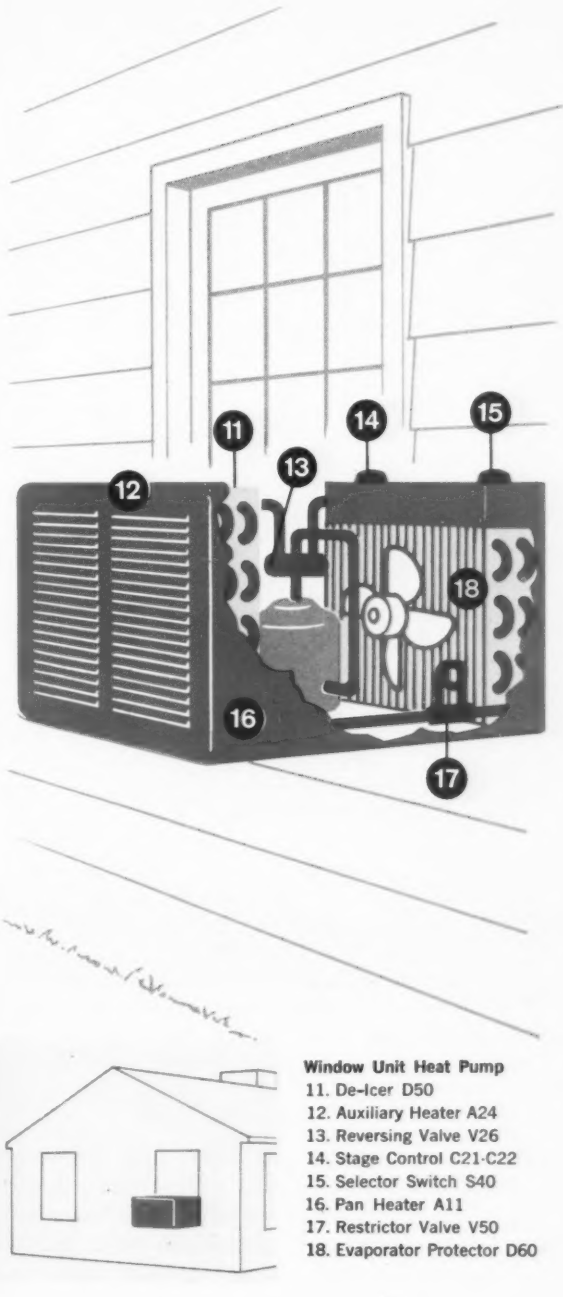
The KING ZEERO Pure Water Cooler consists of a galvanized pipe water coil, a self contained efficient charcoal filter, a KING ZEERO Ice Builder and an ice water recirculation pump, with controls and necessary valves for flow and back wash, all contained in an integral unit.

THE KING ZEERO COMPANY 4300-14 W. Montrose Ave. Chicago 41, Ill.
Manufacturers of Ice Builders - Ice Builder Cabinets - Ice Banks Pure Water Coolers



Split System Heat Pump

1. Evaporator Protector D60
2. Restrictor Valve V51
3. Fan Limit A10
4. Auxiliary Heater A24
5. Reversing Valve V25
6. Pan Heater A11
7. Restrictor Valve V51
8. Crankcase Heater A11
9. Hi-Lo Pressure G
10. De-Icer D52



Window Unit Heat Pump

11. De-Icer D50
12. Auxiliary Heater A24
13. Reversing Valve V26
14. Stage Control C21-C22
15. Selector Switch S40
16. Pan Heater A11
17. Restrictor Valve V50
18. Evaporator Protector D60

Automatic Heat Pump Controls by Ranco

Designed for practical applications, Ranco controls are the most complete and advanced line in the industry, help you take full advantage of the growing market for heat pumps. These new heat pump controls and valves, pioneered by Ranco make heat pump operation automatic and simple for both window-type units and central heating-cooling systems.

The wide line of Ranco controls for heat pumps includes de-icing controls, slide-type reversing valves, and automatic cycling controls. Their practical design permits broad adaptation, plus operation in a wide geographical area. Thorough testing under all types of conditions in laboratory and field assures top performance and dependability.

More than 100,000,000
Ranco Controls now in use

RANCO CONTROLS

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For additional information on the practical application of heat pump controls, contact Ranco today.

Curtis COOLS

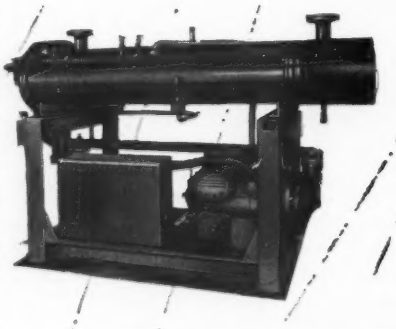
the world's "HOTTEST" towboat...

Huge 180 foot Federal Barge Lines towboat, the United States, has 50% greater horsepower than the largest towboat on the rivers. It can push 40 barges, totaling 1/3 mile, or 300 ft. longer than the "Queen Elizabeth".

C-100

Space saving design versatility? Easy installation? Operating dependability? Comparative cost? All these factors were considered by St. Louis Shipbuilding and Steel Company in the selection of air conditioning equipment for the world's most powerful towboat. The shipbuilders' and their design engineers' careful choice? A Curtis 20-ton packaged liquid chiller system. This equipment will cool the crew's quarters, galley, mess room, officers' and guest quarters—all with individual room or area temperature control.

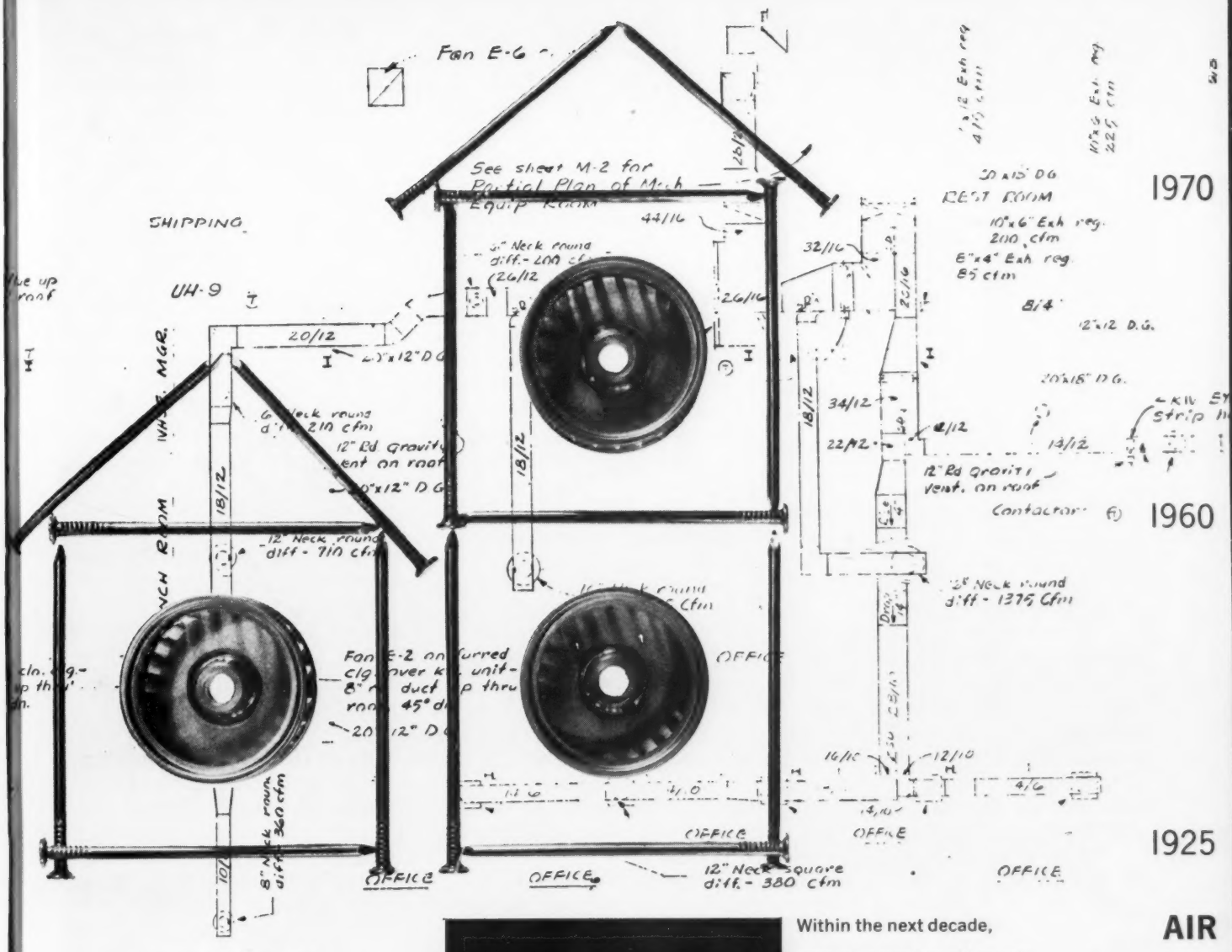
The Curtis complete line, and reputation for dependability in installations of all types, work to the benefit of engineers and mechanical contractors. Factory run-in of all units cuts call backs far below average. You can safely promise dependable performance always up to, and frequently surpassing, rated capacity. You eliminate your problems when you specify Curtis, because you're working with an outstanding manufacturer of air conditioning equipment.



THE COMPLETE LINE OF LIQUID CHILLERS • PACKAGED AIR CONDITIONERS • CONDENSING UNITS

Curtis MANUFACTURING COMPANY • REFRIGERATION DIVISION • St. Louis 33, Missouri

ESTABLISHED IN 1854



AIR MOVING FORECAST FOR 1970

Within the next decade, new construction will equal in value the total U. S. building investment since 1925! **This means as many new ventilating, heating and air conditioning units as the air moving industry has produced in 35 years —and as many problems.** There is no better time than now to point out that Torrington's capabilities in the technology of moving air—and in the production of air moving components—are rated as the finest in the world.

THE TORRINGTON MANUFACTURING COMPANY

AIR MOVING DIVISIONS Torrington, Connecticut; Van Nuys, California; Rochester, Indiana; Oakville, Ontario

(*Continued from page 55*)

the benefits to be derived from living in a more sterile atmosphere. Evidence already collected, however, points to a sharp decline in the spread of contagion, when the atmosphere can be really controlled.

I recommend that total air treatment as discussed today be accepted at once as a key principle in the design of our buildings – schools, offices, factories, hotels and homes. To accept a concept of a controlled environment implies a conviction that every building should be air conditioned (cooled as well as heated) since this is the only way we can control the quality of the air we breathe.

The future importance of establishing a properly controlled environment for living and working is such that considerable emphasis should be placed on research and development to further confirm objectives and improve equipment.

Our practices of building design should be reoriented to the concept of total air treatment. What are windows for? The point is, of course, that with total air treatment windows will have no possible utility other than a scenic diversion. To place this issue in proper perspective would free the designer of traditional cobwebs, permit the design of buildings at lower cost than is traditional, and permit design that would be more functional and of greater utility.

There is no other profession that has the unique heritage of creativity that the architectural profession enjoys. Here is an opportunity.

Future Methods

F. J. LARSEN Our company has recently completed a space cabin simulator for the Air Force School of Aviation Medicine. While the cabin remains on the ground, and is subject to the possibility of over-ride control by observers, two men soon will take a thirty-day "flight" in the small space capsule. The two men, plus complete provisions for all the physiological requirements of breathing, eating, drinking and personal hygiene will be contained in an elliptical cylinder, 5 by 8 by 12 ft.

Atmosphere control was probably the most difficult task our designers faced. Not only were they required to supply clean air, at correct temperature and proper humidity, but altitudes up to 28,000 ft were to be simulated, while percentage of oxygen and carbon dioxide are separately controllable. Carbon monoxide is held to less than 0.07 mm partial pressure. An insulated room around the cabin is cooled to permit normal heat losses from the simulated space vehicle. The outdoor (from the viewpoint of the space cabin occupants) temperature is actually controlled to keep the interior at approximately the correct point. For precise control the air circulated in the cabin is heated or cooled.

Controlling the temperature of a cabin in space, not including the re-entry problem, may be somewhat simpler. Calculations show that total heat losses can be controlled to produce a comfortable temperature by the proper balance of heat-reflecting and heat-absorbing materials on the outer surface of the cabin.

In the simulated space vehicle, air is collected on both sides at the aft end of the cabin and carried through an electrostatic air cleaner which lies beneath a false floor. A catalyzer converts carbon monoxide to carbon dioxide. Without it, the occupants could not smoke. Up to one-third of the air flow can be diverted through Baralyme chemical beds for absorption of carbon dioxide. Downstream from this point baffles direct all of the air through activated charcoal for odor absorption. An adequate, activated charcoal odor removal system was installed.

Humidity control in an occupied, hermetically-sealed cabin is entirely a problem of removing moisture, since the human occupants will continuously give off water vapor. The water removal is accomplished by the conventional technique of a chilling coil to condense vapor plus reheating of the air to the proper temperature. A hermetically-sealed cabin of the type described is not particularly clean. Lint, dried mucus, skin particles, bacteria and tobacco smoke, which includes particulate matter, are all present. The electrostatic air cleaner was a necessity, since it permitted smoking, and removed particulate matter which might otherwise have clogged the activated charcoal filters.

The complete mechanism to dispose of all waste is contained under the floor in the space 18 by 30 by 18 in. Solid wastes are incinerated; all liquid wastes are distilled, frozen and passed through activated charcoal. The water which results is purer than that we ordinarily consume, and is used for drinking and washing.

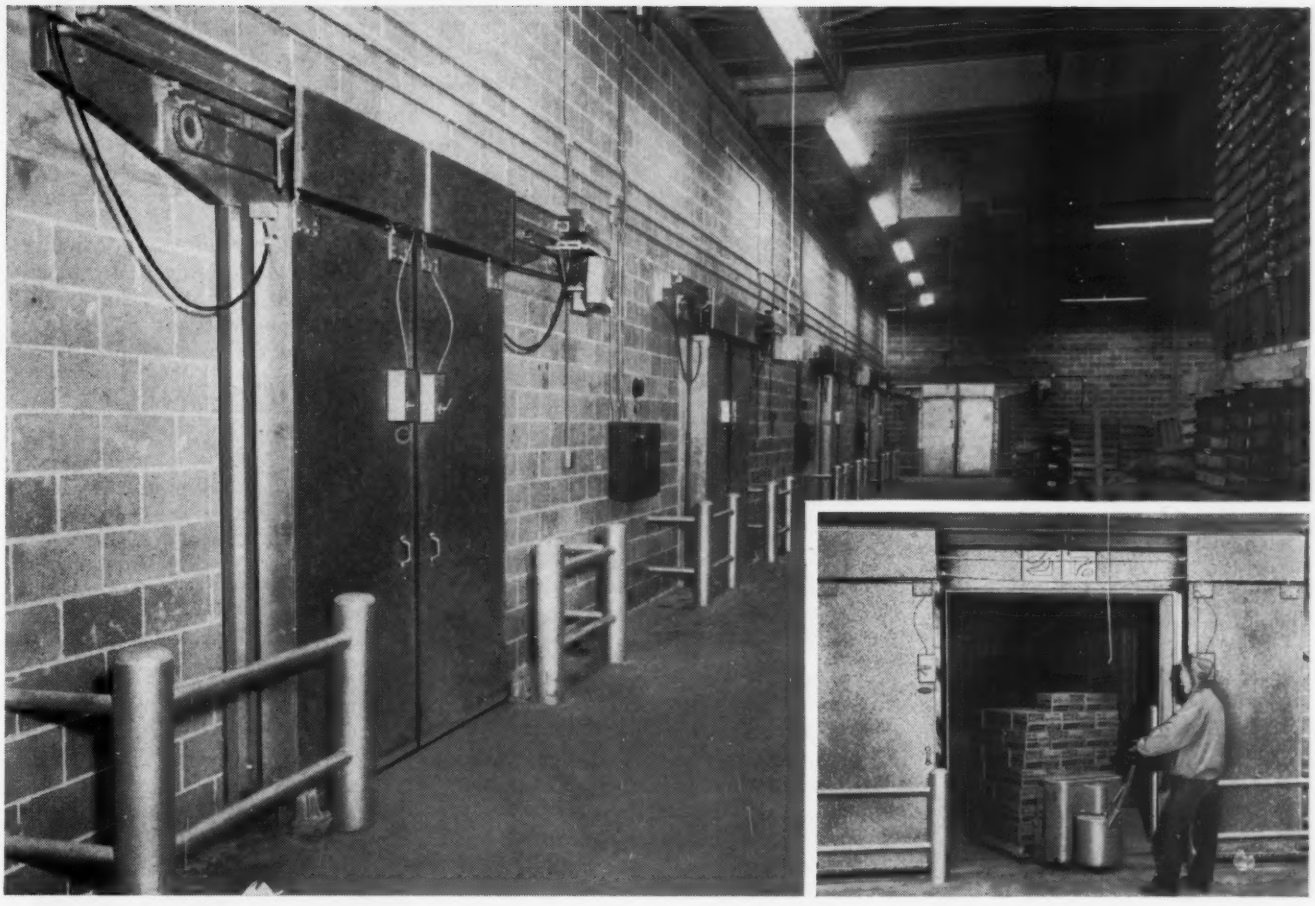
One of the most interesting aspects of the space cabin project is that it is possible to deal with the most difficult ecological problems, and that the techniques of handling them are not appreciably different from the methods in current use by the air conditioning industry.

While tremendous strides have been made in home and office comfort during the last few decades, the approach to true comfort and complete control of our environment is only well underway.

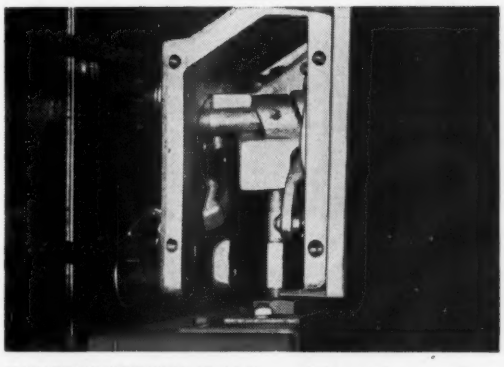
Have we reached the golden age of comfort? Can we go even further in controlling our environment? Many research scientists believe that we are just beginning to have insight into some very interesting possibilities – including negative ions.

But even the salubrious effects of good air conditioning should be only the beginning. If we can determine and then produce the ingredients of an atmosphere that can invigorate, we should also be able to produce a relaxing, soothing environment. If eventually we are successful in achieving complete control of our indoor atmosphere, we might be able to do even more than simulate various outdoor atmospheres. Why not control moods? Instead of con-

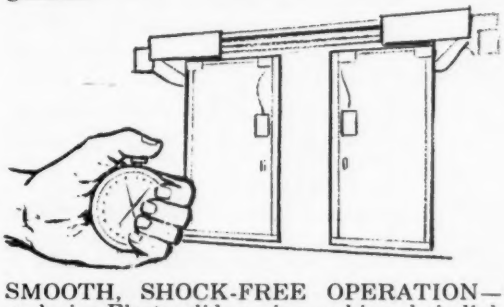
F. J. Larsen is Vice President of Research, Minneapolis-Honeywell Regulator Company.



9 Jamison **Electroglide**® Doors handle heavy traffic—save refrigeration



COMPRESSION SEAL—refrigeration savings assured by cam lock—in and down action on gaskets.



SMOOTH, SHOCK-FREE OPERATION—exclusive Electroglide spring cushion chain link absorbs inertia on opening, absorbs momentum when stopping.

Insulator: Mid Continent Industrial Insulation Co., Kansas City, Kansas.

Contractor: A. W. Soderberg Construction Co., Wichita, Kansas.

• In Wichita, Kansas, at the big Safeway Cold Storage Warehouse, nine Jamison Electroglide Power Operated Cold Storage Doors demonstrate how they permit high volume, high speed warehouse operation.

Exclusive Jamison features of the Electroglide assure fast, positive operation with safety to personnel.

LEVEL RIDE—opening and closing without gasket wear or drag.

RANGE OF TYPES—available bi-parting and single leaf left or right hand operation.

PADLOCK WITH SAFETY—emergency inside release.

MANUAL OPERATION—possible when power is off.

For Electroglide bulletin—Write Jamison Cold Storage Door Co., Hagerstown, Md.

JAMISON

COLD STORAGE DOORS

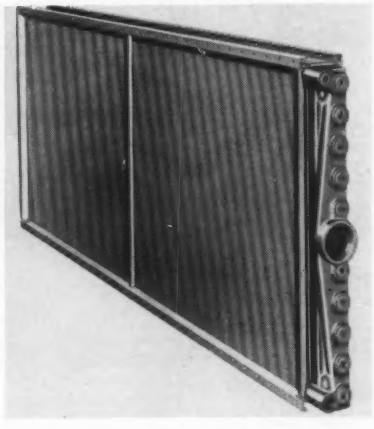
tinuing to feel dull and logy and irritable, we might select an invigorating, exhilarating atmosphere and at least modify the depressed attitude. Or the reverse might be true; a properly selected atmosphere could make a nervous, frenetically busy homemaker more relaxed and less worn out at the end of the day.

If this becomes possible, our air conditioning systems will indeed be approaching their "golden age." They will be near their ultimate development when they directly control man's moods and happiness.

PARTS and PRODUCTS

HEATING COILS

Cited as being, on the average, 40% smaller than previous coils with comparable capacities, this new line features a configuration of S-shaped contours die-formed in the metal fin to provide higher performance. Function of the Sigma-Flo pattern is to improve turbulence in the flow of air as it passes over and makes contact with the heat transferring surfaces of the coil. Each contour of the fin breaks up the flowing air and creates a turbulence over the entire surface to assure effective heat transfer over the entire fin area.



As part of the heating coil line, the manufacturer has developed a straight tube-within-a-tube steam distributing coil cited as producing uniform leaving air temperatures. Steam is distributed into large one-in. diam outer tubes through the directional kinetic orifices of the inner tube, condensing as it is ejected and permitting efficient heat exchange.

Trane Company, La Crosse, Wisc.

MECHANIZED CUTTER

Designed primarily for cutting round openings in tanks and large diam pipe, this cutter makes straight, irregular or circular cuts in flat plate with equal speed and accuracy. A magnetic radius rod permits center fulcrum to rise and fall with the contour of the tank and an oxy-acetylene torch powered by a small 110 volt variable speed motor, makes it adaptable to cutting varying thicknesses. Removable handle permits plate cutting from a standing position.

Steffan Manufacturing Corporation, P. O. Box 275, Salem, Ohio.

HERMETIC COMPRESSOR

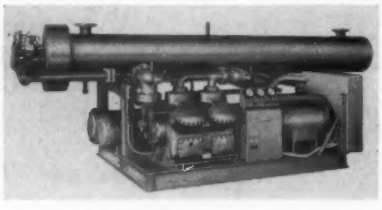
Approximately half the weight and size of previous models, the Micromite contains less than half as many parts as its predecessors and is designed for low maintenance. Two room air conditioner models are the first units in the line to be introduced, with central air conditioning units with capacities up to four ton to follow.

Operation of the compressor is at 3500 rpm, twice that of previous models, but piston and bearing speeds remain the same because piston strokes and bearing diam have been reduced. Only two threaded connections are used in the entire assembly, nuts, bolts and gaskets have been eliminated, and a welded steel shell is cited as eliminating potential sources of leaks.

Carrier Corporation, Syracuse 1, N.Y.

DIRECT-DRIVE UNITS

Sizes represented in this line of direct-drive and semi-hermetic packaged



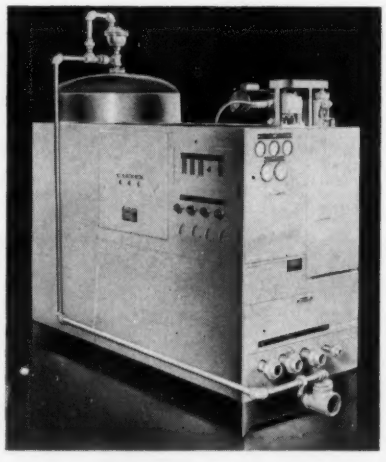
liquid chillers range from 75 through 125 hp in the former and 7½ through 60 hp in the latter compressors. All are designed for high-efficiency chilling of brines, glycol, oils, solvents, alcohol, kerosene, gasoline, water and other liquids.

As with the manufacturer's regular line of open type reciprocating compressor units, these chillers are adapted for operation with all types of air handling equipment, whether central station, individual room, multi-zone or remote type units. Matched components are featured in the units, which are shipped completely assembled.

Curtis Manufacturing Company, Refrigeration Div, 1905 Kienlen Ave., St. Louis 33, Mo.

CONTROL SYSTEMS

Design of this line of automatic Side-Stream boiler water control systems has been extended to service boilers operating up to 600 psi, due to increased demand for high pressure installations. Sized for steam boilers up to 3000 hp, these new models feature control of boiler water silica content



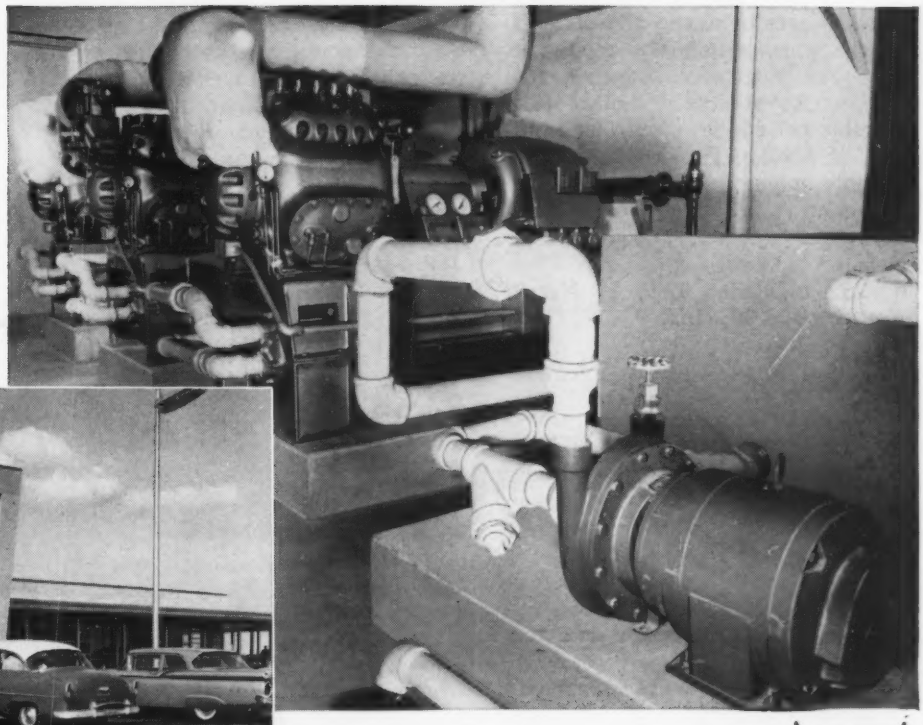
and provide automatic detection and control of soluble condensate contaminants and positive filtration of insoluble contaminants such as suspended oils, fats and waxes.

In addition to expansion of this line, the manufacturer is extending its operations to include automatic side-stream filtration for various other process systems, including inline chemical and liquid purification for segregation of reclaimed fluid and discharge of both suspended and dissolved contaminants.

Sparkler-Filtrion Corporation, North Chicago, Ill.

WATER SOFTENER

Offered in five models, this automatic water softener has a grain capacity range from 22,500 to 75,000 grains per regeneration. Each unit has an automatic control which regenerates



INDIANA TOLL ROAD *INTERSTATE* HOSTS *Commissary*

COOLED BY B&G® CONDENSING UNITS

Three low temperature B&G Condensing Units handle the refrigeration requirements of this well known restaurant chain unit at Elkhart, Indiana.

B&G Condensing Units offer a completely capacity-engineered combination of B&G Chassis, B&G Motor, B&G Compressor, B&G Condenser and automatic capacity control. B&G builds *all* these components into a unit specifically designed to meet the requirements of the installation.

Exceptionally rugged construction and low center of gravity assure damage-free installation. Bell & Gossett refrigeration equipment, as in all of its many products, is built to provide years of dependable service—always ready to meet the challenges of unusual conditions.

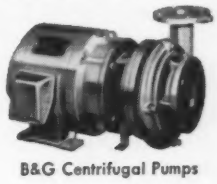
BELL & GOSSETT
COMPANY
Dept. GE-64, Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong, Ltd.
1400 O'Connor Drive, Toronto 16, Ontario

A COMPLETE LINE OF REFRIGERATION AND AIR CONDITIONING "PACKAGES" AND COMPONENTS

B&G Package Liquid Coolers

B&G Evaporators



B&G Centrifugal Pumps

B&G Condensers

at the proper time, and an automatic by-pass which maintains a continuous supply of water, even during regeneration. An additional feature is a movable polyethylene brine tank capable of holding 200 lb of dry salt. Flexible tubing permits the tank to be placed as far as ten ft away from the water softener, allowing easier installation or servicing.

Bomarc Industries, Inc., 17 Nassau Ave., Inwood 96, N. Y.

ELECTRONIC SENTRY

Designed to keep a constant watch over refrigeration or air conditioning systems and signal equipment failure or inefficiency, this electronic device is cited as detecting refrigerant leaks, inefficient operation of compressor, broken or slipping V-belts, flash gas conditions, restricted strainer or dryer, loose free-turning motor pulley or compressor drive pulley, tripped reset or motor overload device, a defective compressor motor and blown fuses, conditions that might result in non-operation of the compressor while the compressor motor control is calling for refrigeration.

Special low voltage thermal switches are available which can be located in the refrigerated space and connected to the Sentry so that it will signal temperature rise. These switches are so designed as to prevent false alarms during defrost periods or periods of a normal temperature rise.

Basically, the Sentry consists of a sensing probe located in the liquid line of the system, and a main electronic control unit. A multiple selector switch which permits up to five condensing units to be connected to a single device and a low voltage remote alarm light are also available. One standard unit operates on 60 cycle, 115, 208 or 230 volt ac and can be used on any size equipment and with all refrigerants.

Televance Corporation, P. O. Box 3043, St. Louis 23, Mo.

AIR-COOLED LINE

As a companion to its other lines of residential and light commercial air conditioning, this company has introduced a line of air cooled equipment, designated Corsaire and comprised of seven remote condensing units in four capacities: 23,000, 34,000, 46,000 and 57,000 Btu/hr. Featured in the system are service valves, moisture indicator, condenser guard, year-round thermostat, two-speed fan control panel, quiet propeller fan and split capacitor fan motor.

Cooling coils include upflow, downflow, horizontal flow and blower-coil

units for commercial use. All coils are designed to fit standard Rheemaire plenum cabinets and applicable furnaces.

Self-contained Corsaire units are available in 22,000 and 33,000 Btu/hr capacities, and are designed for use where a cooling system independent of the heating system is desired. Installations include rooftop, attic, crawl space and through-the-wall use.

Rheem Manufacturing Company, 7600 S. Kedzie Ave., Chicago 52, Ill.

TESTER-ACTIVATOR

For testing and activating air conditioning units for automobiles before the cars reach the end of an assembly line, this self-contained machine performs a series of operations automatically. It cleans the entire system in the car by dry air with a −100 F dew point and then tests the system for leaks by introduction of a nitrogen-halogenated hydrocarbon vapor under 200 psi pressure. This vapor is reclaimed for reuse and is evacuated to 29.3 of mercury. At this point, the Tester and Activator introduces a correctly-weighed charge of refrigerant into the air conditioner, automatically refills the weighing cylinder and turns itself off.

A dual machine, the unit is designed to handle two assembly lines simultaneously. Safety valves and automatic flash controls are built in. Two tanks supply refrigerant to permit continuous operation. When one tank empties, the machine taps the second tank, a flasher on a control panel indicating that a tank is empty.

Alpha Electric Refrigeration Company, 1115 E. Seven Mile Rd., Detroit 3, Mich.

LARGE-DIAL THERMOSTAT

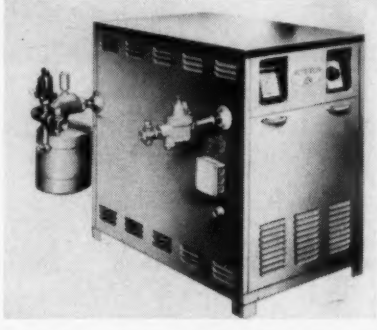
Dial on the Diamond Jubilee Round, which has the basic appearance and characteristics of the company's original round model, is 40% larger than viewing dials on earlier models and size of the indicating numerals has been increased 20%. In addition, the set point scaleplate is located at the top of the thermostat and the thermometer scale is at the bottom, to facilitate dial reading.

Minneapolis - Honeywell Regulator Company, 2747 4th Ave., Minneapolis 8, Minn.

BOILER COMPONENTS

Standard components of the Ruudiator prefabricated house-heating gas-fired hot water boiler are now an Extrol expansion tank, air purger and automatic air vent.

Advantages cited for the expansion tank include: a permanent air cushion, simple installation, minimum space requirement, low cost, no maintenance, no waterlogging, reduced air



noises, no weeping relief valves, reduced system corrosion and neater appearance. In service, it provides a sealed, flexible diaphragm between the water and the air so that they never come in contact.

Removing air and gases from the system, the air purger and vent complete the combination which serves to minimize rust and corrosion.

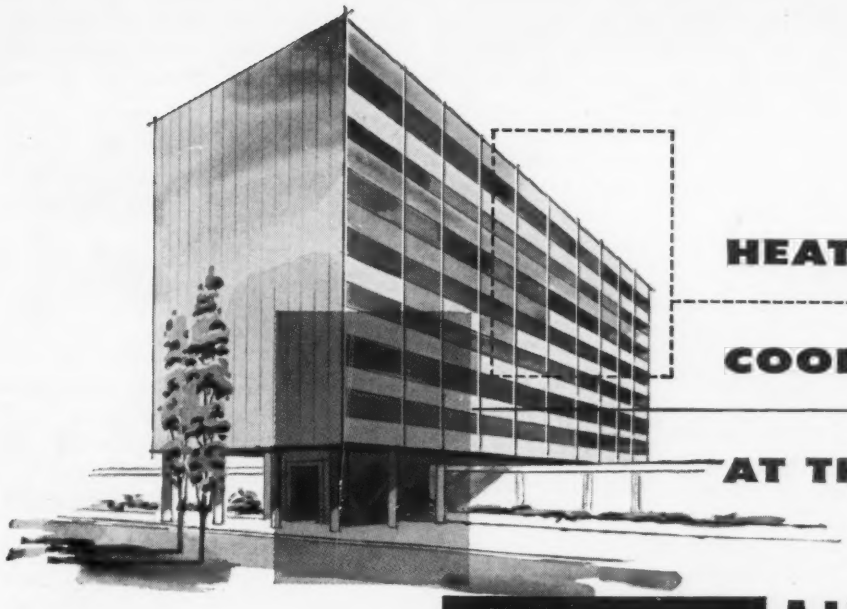
American Tube Products, Inc., West Warwick, R. I.

AIR COMPRESSORS

Design of these portable, oil-free, piston-type compressors is cited as assuring maintenance-free operation by eliminating lubrication and diaphragms which could rupture. Included in the non-lubricated piston is a specially compounded Teflon

cup backed by a silicon O-ring. Cylinder liner is made from corrosion-proof and wear-resistant stainless steel.

Self-contained and ready to plug into an electrical outlet, these units are available with an automatic safety

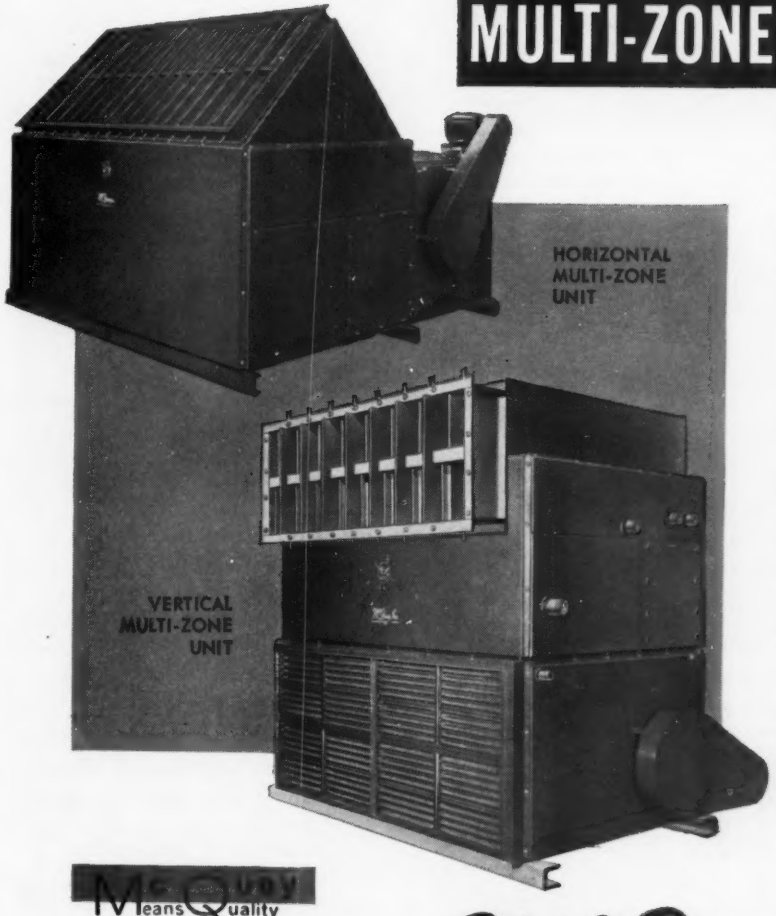


HEAT ONE SECTION

COOL ANOTHER—

AT THE SAME TIME

McQuay MULTI-ZONE AIR CONDITIONERS



You choose your own weather with McQuay "MC" Multi-Zone air conditioners—even to heating some sections of a building while you cool others. You can furnish balanced comfort simultaneously to different, determined areas with either filtered, cooled and dehumidified air; or filtered, heated humidified air—or a mixture of these in any desired proportion—at your command.

McQuay "MC" Multi-Zone air conditioning units are available in 11 sizes from 1370 cfm to 38,000 cfm. Each unit has a standard number of zones available from 6 on the smallest to 22 on the largest. All zones are interconnected by a single external connecting rod. A full line of accessories is available . . . preheat steam coils, filter sections, mixing boxes, humidifiers.

McQuay "MC" units, of course, feature the famous McQuay Ripple-Fin coils for highest efficiency and Dura-Frame "V" channel construction for strength and rigidity. When you use McQuay, you can be sure that engineering research and know-how have produced the finest, most efficient and dependable equipment available. McQuay, Inc., 1606 Broadway Street N.E., Minneapolis 13, Minnesota.

McQuay Means Quality

McQuay INC.

AIR CONDITIONING • HEATING • REFRIGERATION

bleed-off valve to release pressure in excess of pre-selected amounts, up to 100 psig.

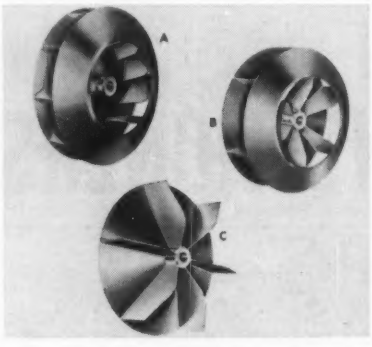
Motor is ⅛ hp, 115 volt ac (3 amp) induction type and is equipped with standard eight-ft heavy duty plug-in cord with thumb switch.

Winslow Manufacturing Corporation, 3695 E. 10th Ct., Hialeah, Fla.

INDUSTRIAL FAN LINE

Available in three basic wheel designs for handling gases, corrosive fumes, granular or fibrous materials, fans in this line are manufactured in all standard wheel sizes from 19⅛ to 64⅜ in. and a range of 11 inlet sizes from 11 to 37 in.

Air handling wheels (upper left in the cut) have backwardly inclined



blades for high efficiency, a granular materials handling wheel (upper right) has straight blades and a long strand handling wheel (bottom) is without side plates to permit easy passage of fibrous materials such as those found in textile and woodworking mills. Blades in all three types are continuously welded, wheels and fan shafts are machined to tight tolerances and heavy-duty ball bearings are standard. Split housings are available for limited access installations.

Trane Company, La Crosse, Wisc.

VENTURI BURNERS

Units in this line of inshot and upshot venturi burners are of all-steel construction, stamped and welded for light weight and flexibility, for installation in furnaces, boilers and hot water heaters. Features include varying venturi lengths, different spreader heights, various flame spreader shapes and Btu inputs ranging from 5000 to 400,000 Btu depending on the application.

Barber Manufacturing Company, 1052 E. 134th St., Cleveland 10, Ohio.

PACKAGED CHILLERS

Addition of packaged water chillers of 100 and 125-ton to this line brings to eight the number of models offered. Ratings are now 20, 25, 30, 40, 50, 60, 100 and 125-ton.

Through use of matched components and engineering efficiencies, both size and weight of the units have been reduced approximately 50%. Featured in the new chillers are a hermetic compressor, a greater ratio of heat transfer capacity to shell size for the Dry-Ex cooler and a control box which can be locked. If intended for use with air-cooled or evaporative condensers, the unit may be obtained without a factory-installed condenser.

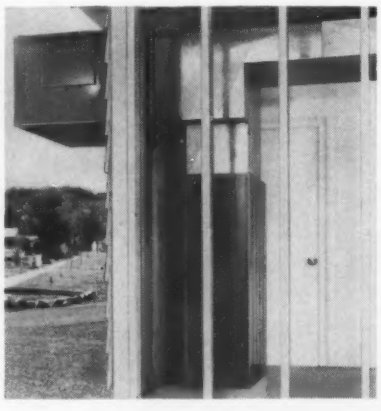
Acme Industries, Inc., Jackson, Mich.

INSTALLATION METHOD

Development of a simplified furnace-cooling unit connecting device, produced in the factory, should permit low-cost, rapid installation of year-round air conditioning in homes.

Comprising the connection are a prefabricated metal sleeve which is installed in the wall near the furnace and a compact transition assembly which connects the furnace to the summer air conditioner. Provided by the wall sleeve is a close-fitting, strong support for a horizontal one-piece cooling unit, suspended on the outside wall without benefit of knee braces. Fitting into the sleeve, the transition assembly controls the flow of air between furnace and cooling apparatus.

As shown, air flow from the furnace in winter is discharged directly into

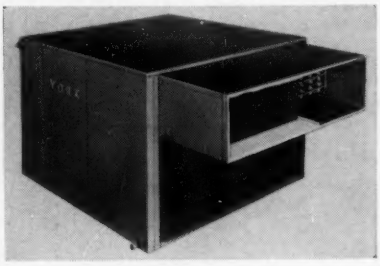


the duct leading to the right. In summer, the cooling unit located outside the home, at left, draws air from the furnace plenum and returns it to the top of the plenum for distribution throughout the house.

Carrier Corporation, Syracuse 1, N. Y.

HEAT PUMP LINE

To meet the market for all-electric heating and cooling, this packaged product heat pump line for 1960 has been expanded to include seven room air conditioner models. Five of these are available with auxiliary electric heat to provide additional warmth when temperatures drop and feature automatic defrost. During the defrost



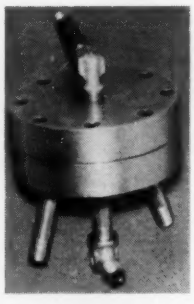
period, the fan is shut off automatically to prevent cold air from entering the room. On mild days, heat pump units automatically switch from heating to cooling as needed to maintain the pre-set room temperature.

For residential and commercial needs, heat pumps in three product groupings are offered: air cooled, attic-type Pathfinder units, in two, three and four-ton sizes; Model HP36 (shown), providing heating and cooling over a temperature range from zero to 115 F; and remote five and seven and one-half-ton units.

York Div, Borg-Warner Corporation, York, Pa.

MANIFOLD VALVE

Having only one moving part, this differential pressure manifold valve may be actuated on the control side by air, gas or other fluids, while the working side can handle the same or other gases, fluids or slurries. It is available in a variety of materials, including aluminum, brass, nylon, Teflon and stainless steel. Flow of an entering fluid can be divided two to six ways by the working side. Operating differential is one oz/sq in. to 145 psi.

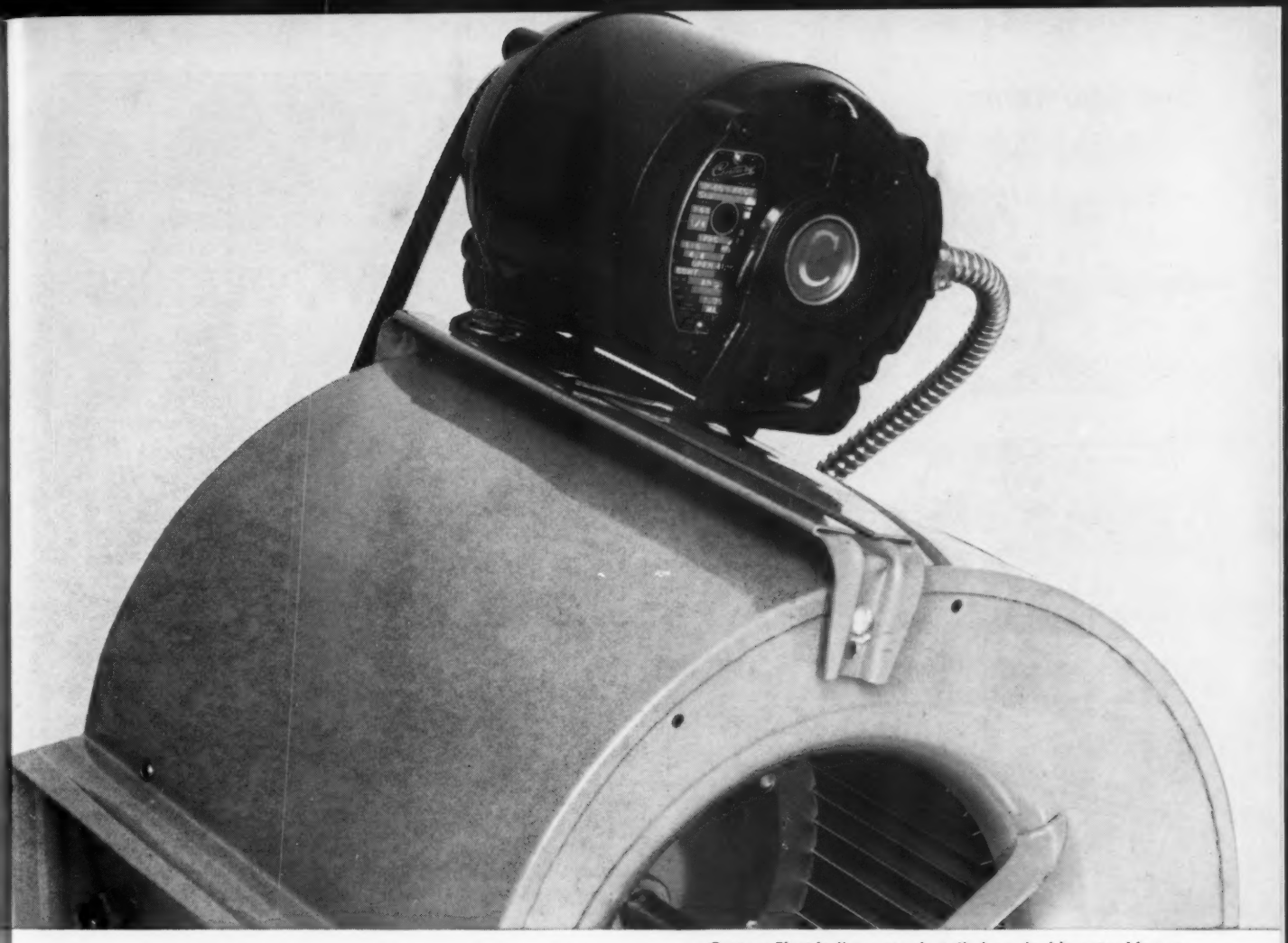


Frankel Engineering Laboratories, Inc., 207 S. Fifth St., Reading, Pa.

REPLACEMENT MOTOR

For replacement of motors in room air conditioners and furnace blowers, this permanent-split capacitor motor has been produced as a companion to the manufacturer's shaded-pole replacement motor. With adjustable mounting adapter, the new motor permits substitution for almost any 5½-in. diam permanent-split capacitor motor.

Adjustable mounting adapter supplied with the motor can be installed by a repair or service man. Positioning of the adapter permits the mounting ring to be located from a min of



Century Electric fhp motor installed on double entry blower.

Why Century Electric motors give quiet, dependable service

Century Electric motors designed for the air conditioning and warm air heating industry help reduce costly service calls. Here are a few of the features that give quiet, dependable operation.

QUIET BECAUSE cushion base has resilient rings which keep motor from metallic contact with base. Result: reduced transmission of sound vibrations.

QUIET BECAUSE it has sleeve bearings. The shaft floats on a film of oil. You can pull the belt up without getting any bearing rumble.

QUIET BECAUSE rotor bars, end rings and fans are all integrally cast of aluminum. Rotor is dynamically balanced to assure extra smooth operation.

DEPENDABLE BECAUSE lubricating method is designed to withstand warm air furnace operating conditions.

DEPENDABLE BECAUSE insulation consists of bonded paper and "Mylar" slot cells and high temperature baking varnish. Result: high mechanical and dielectric strength.

DEPENDABLE BECAUSE of features like trouble-free governor; automatic thermal overload protection; positive grounding strip on cushion rings and pressure cast aluminum bearing brackets.

Also available: Two-speed motors for combination heating—air conditioning units; and 56-frame motors when half horsepower capacity and larger is required. For more information contact your nearest Century Electric Sales Office or Authorized Distributor.

CENTURY ELECTRIC COMPANY

St. Louis 3, Missouri *Offices and Stock Points in Principal Cities*

Century 59-20

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DIVISION OF HAGAN
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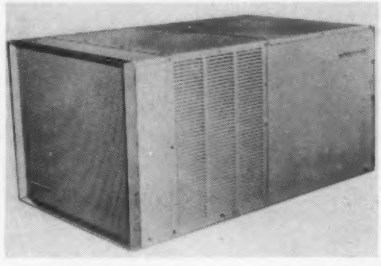
4⅝-in. motor length to a max of 5⅛-in. Adapter can be omitted for band-mounting of the motor or for applications requiring mounting through bolts.

Motor is available in six-pole models from 1/15 through 1/6 hp, 115 or 230 volt.

General Electric Company, Schenectady 5, N. Y.

PACKAGED UNITS

Factory packaged like window air conditioners but more powerful, units in the Tuckaway line need only to be plugged in, hooked to the thermostat and connected to the air distribution ducts. Cooled, filtered, dehumidified



air is provided automatically for whole-house air conditioning.

Air-cooled, the two, three and five-hp units require no water or cooling tower connections. They can be installed in attic, basement, crawl space, or outside the home on a concrete slab. In store installations, the unit may be mounted on the roof or installed through a transom over a door. Units are equipped with single heavy duty refrigerant-cooled compressors that operate on single-phase, 230-volt power. The five-hp unit is also available for three-phase power.

Perfection Industries Div, Hupp Corporation, 1135 Ivanhoe Rd., Cleveland 10, Ohio.

AIR-FLOW METER

Revolving drum-type, 25 in. circumference dial on this meter permits direct read-out of all flows from 20 to 200 cfm at any pressure from 2 to 12.5 psig. Long calibration range of the dial, plus dampening by paddles turning in oil in the drum reservoir, provides direct deadbeat readings at any point throughout the circumference of the dial.

Actuating the dial is a turbine wheel attached to a spring wire stretched within a vertical duct. As air-flow velocity rotates the wheel, the torque created is opposed by the spring of the wire, thus registering the rate of flow on the dial. Pressure drop through the instrument is less than 0.1 psi.

Highland Engineering Company, 1740 Berkeley St., Santa Monica, Calif.

REMPE
Heat Transfer Equipment

CARBON STEEL
EVAPORATORS

For Comfort Cooling

Ammonia Coils for 25° to 50° F. suction temperature and air velocities of 400 to 700 FPM are available. This design uses ⅝" OD tube on 1½" centers with 6 fins per inch. Furnished with distributors in sizes 3 to 50 tons. Similar modifications can be used in 0 to plus 40° F. for process work. Copper tube and aluminum fin construction also available.

FABRICATED
PIPE COILS

Unlimited Applications

Coils illustrated are a double spiral made from nickel pipe. They were designed for use as part of a continuous fat splitting unit employing the Eisenlohr Process. The coils were tested to 12,000 lbs. hydrostatic pressure for operation at 3,500 lbs. steam pressure and 600° F.

Send Drawings for Quotation

Engineering Data Book
Pipe Coil and Fin Coil Designs. Heat Transfer Coefficients. Get a copy for your library.

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Catch-Alls have FAMOUS FIRSTS too!

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- Molded Porous Core
- Only Full Flow Filter-Drier

1948

- Tamper Proof Seals

1949

- Replaceable Core Models
- Cores individually packed in hermetically sealed metal cans

Modifications will always be made, but only to improve the product... never to change it!

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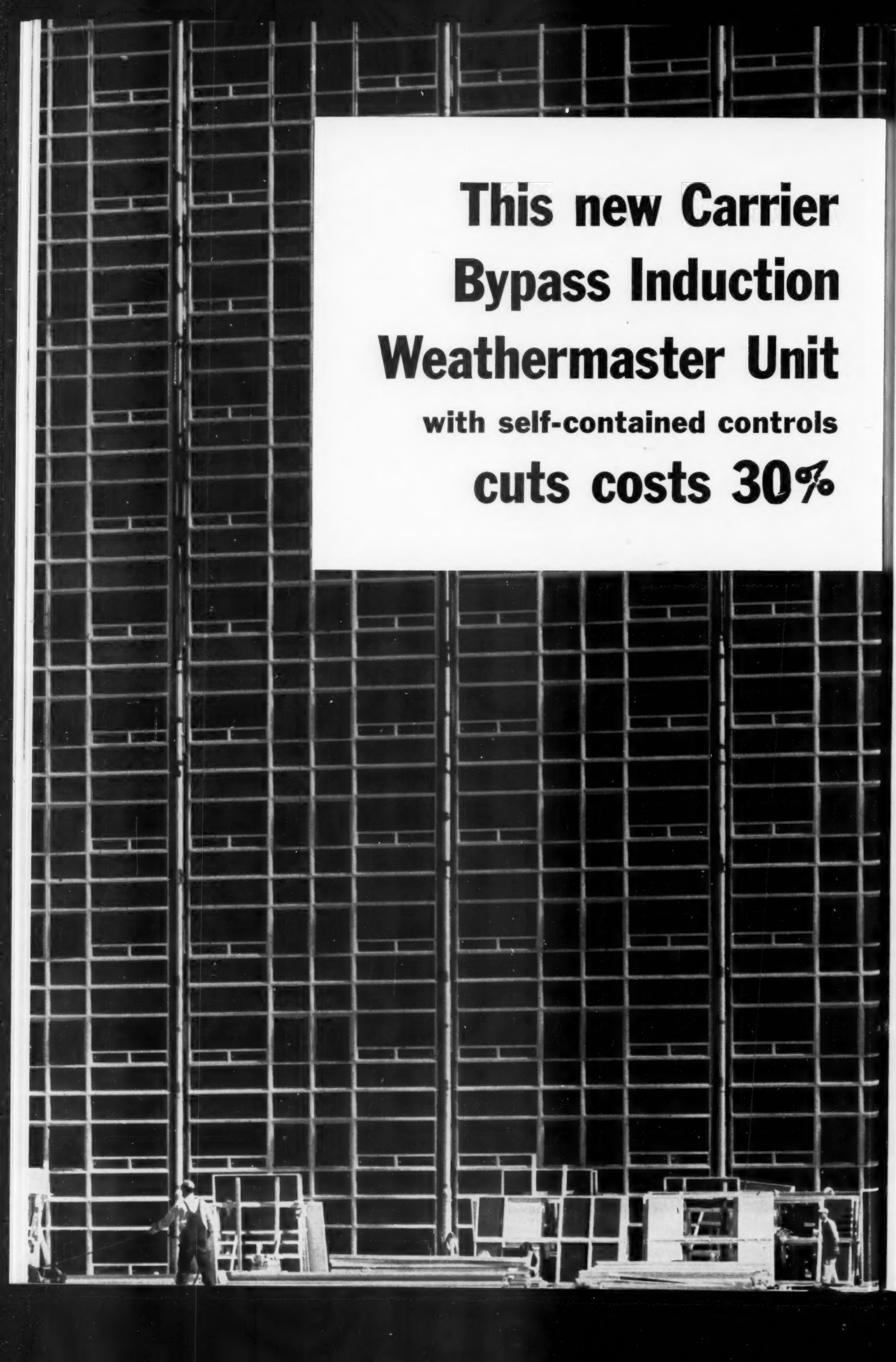
Catch-Alls are available for any system – fractional horsepower to over 100 tons



This new Carrier Bypass Induction Weathermaster Unit

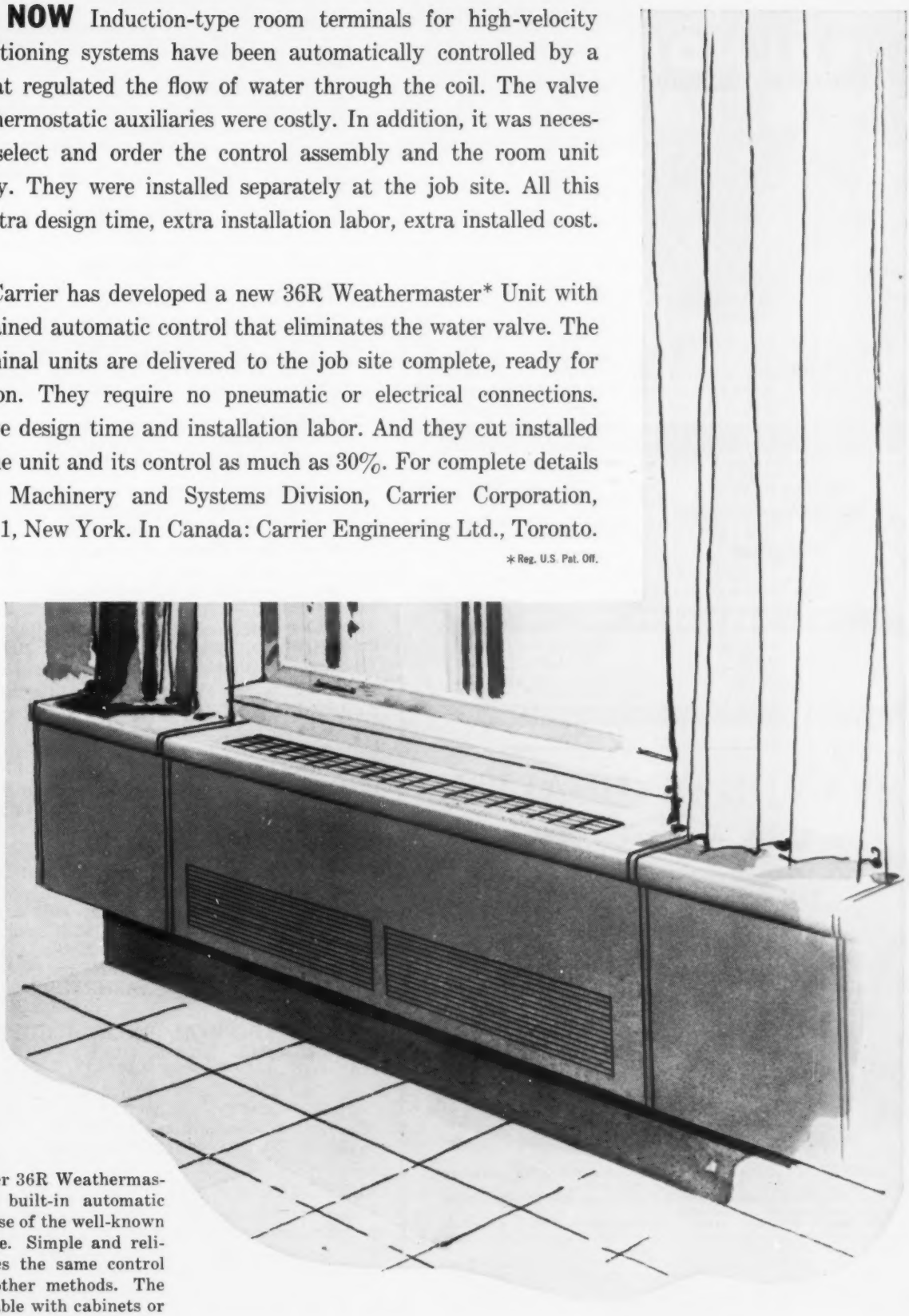
with self-contained controls

cuts costs 30%

UP TO NOW Induction-type room terminals for high-velocity air conditioning systems have been automatically controlled by a valve that regulated the flow of water through the coil. The valve and its thermostatic auxiliaries were costly. In addition, it was necessary to select and order the control assembly and the room unit separately. They were installed separately at the job site. All this meant extra design time, extra installation labor, extra installed cost.

NOW Carrier has developed a new 36R Weathermaster* Unit with self-contained automatic control that eliminates the water valve. The new terminal units are delivered to the job site complete, ready for installation. They require no pneumatic or electrical connections. They save design time and installation labor. And they cut installed cost of the unit and its control as much as 30%. For complete details write to Machinery and Systems Division, Carrier Corporation, Syracuse 1, New York. In Canada: Carrier Engineering Ltd., Toronto.

*Reg. U.S. Pat. Off.



The new Carrier 36R Weathermaster Unit with built-in automatic control makes use of the well-known bypass principle. Simple and reliable, it provides the same control versatility as other methods. The units are available with cabinets or for furred-in applications.

MORE PROOF OF
BETTER AIR CONDITIONING FOR EVERYBODY EVERYWHERE

Carrier

Use Harry Alter's Famous

DEPENDABOOK

Specializing in

- **Air Conditioning**
- **Refrigeration**
- **Electric Motors**

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New! 240 value-packed pages

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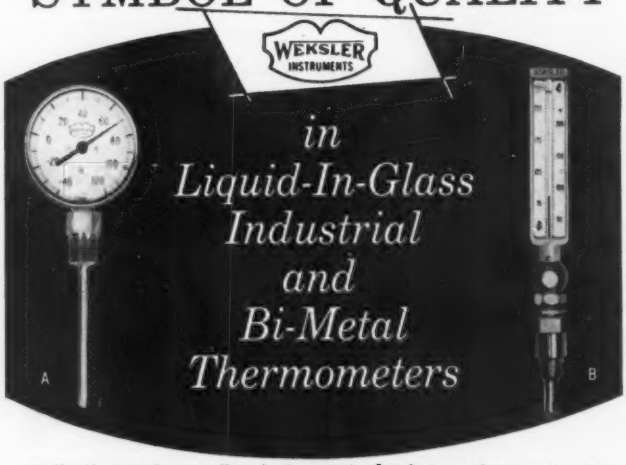

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MANUFACTURER'S AGENTS wanted in several key trade areas to represent our complete line of air conditioning products. For information write Manager, Air Conditioning & Refrigeration Division of Crane Co., Johnstown, Pa.

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troductory period. Send resume of experience, education and salary requirements to Box 963, ASHRAE JOURNAL.

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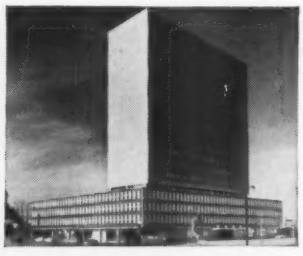
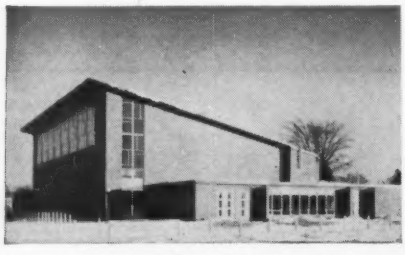
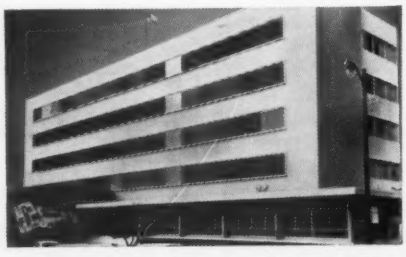


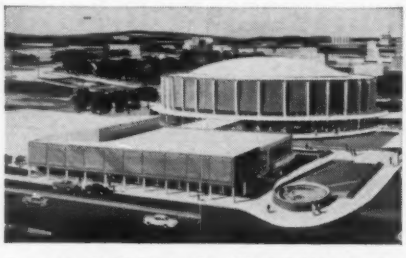
High velocity system handles 87,000 cfm; 74,000 cfm is recirculated, 40% through B-C filters, at Houston Medical Towers.



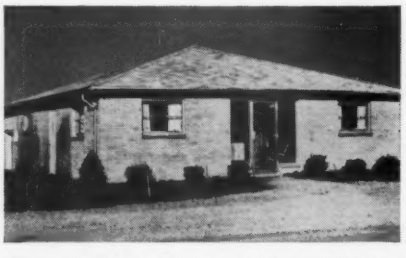
$12,000 was saved in heating installation for this church and school; heating costs cut $1,650 per year, with B-C filters.



B-C permitted reducing outside air intake to 5% in this California Teachers Association building, Los Angeles.



Over 200 B-C filters handle 218,000 cfm in conjunction with electrostatic filters at this Dallas auditorium.



The characteristic aroma of a veterinary hospital is missing from this one, thanks to B-C activated charcoal.

activated charcoal air purification

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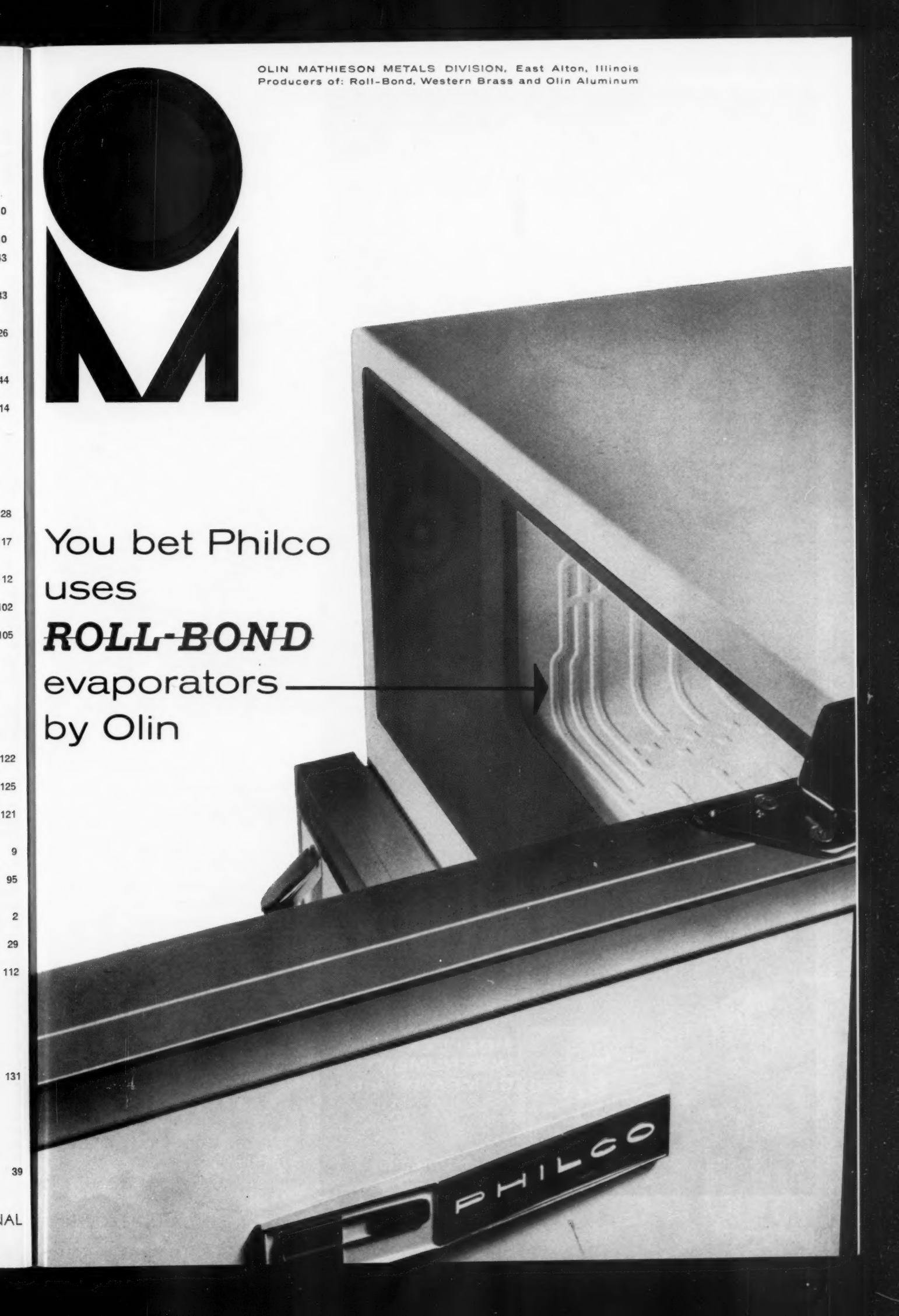

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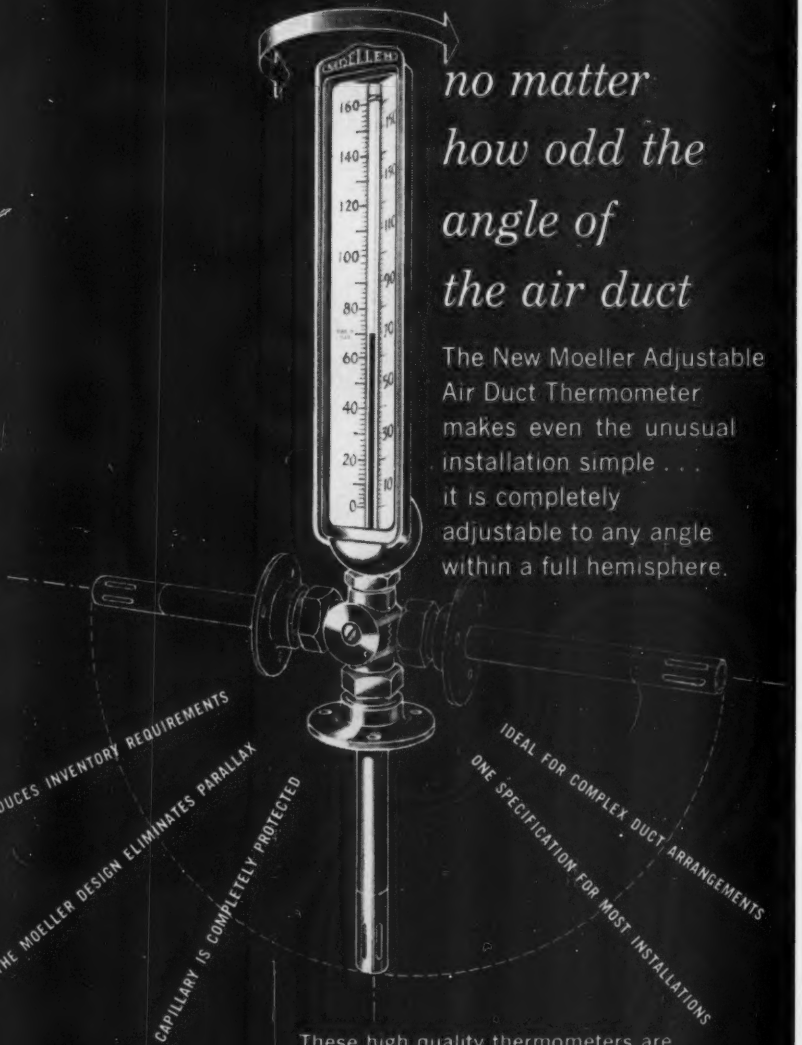

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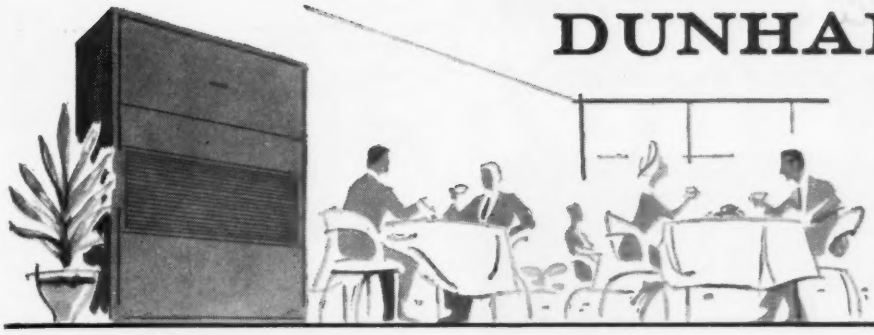

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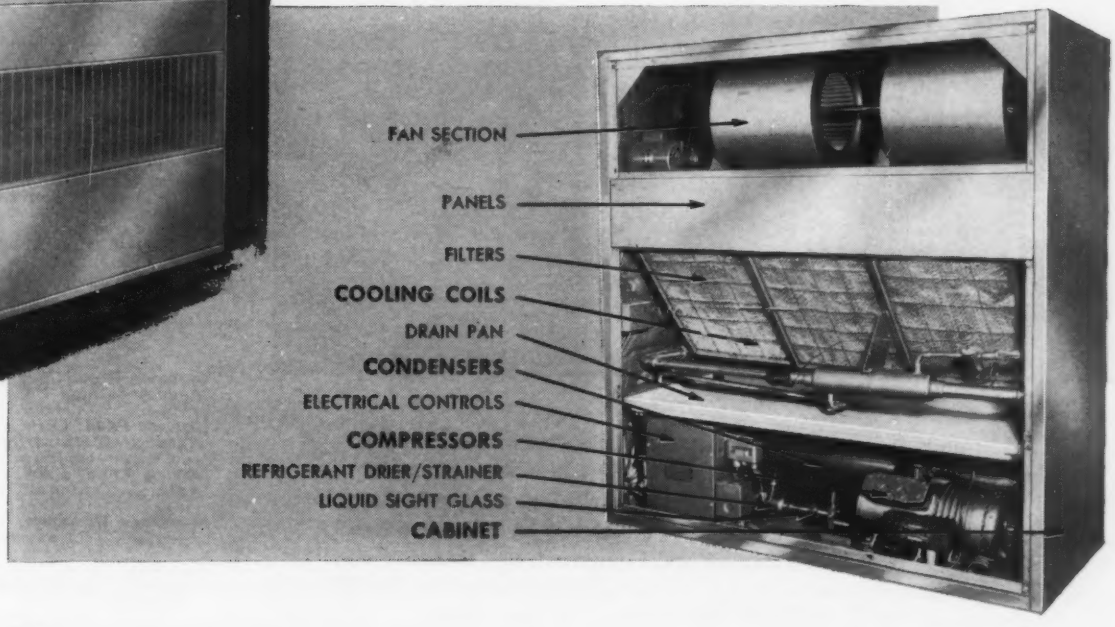
Proves how to properly package air conditioning



Important to contractors and specifiers is peak performance of Dunham-Bush "PAC" Packaged Air Conditioners, achieved through pre-engineered major components. Other manufacturers, using components from diverse sources, must attempt to improvise balance. But Dunham-Bush manufactures and designs the motor compressor, condenser, evaporative coils and cabinet specifically for "PAC". This "one source-one responsibility" is evident in dependable operation and customer satisfaction.

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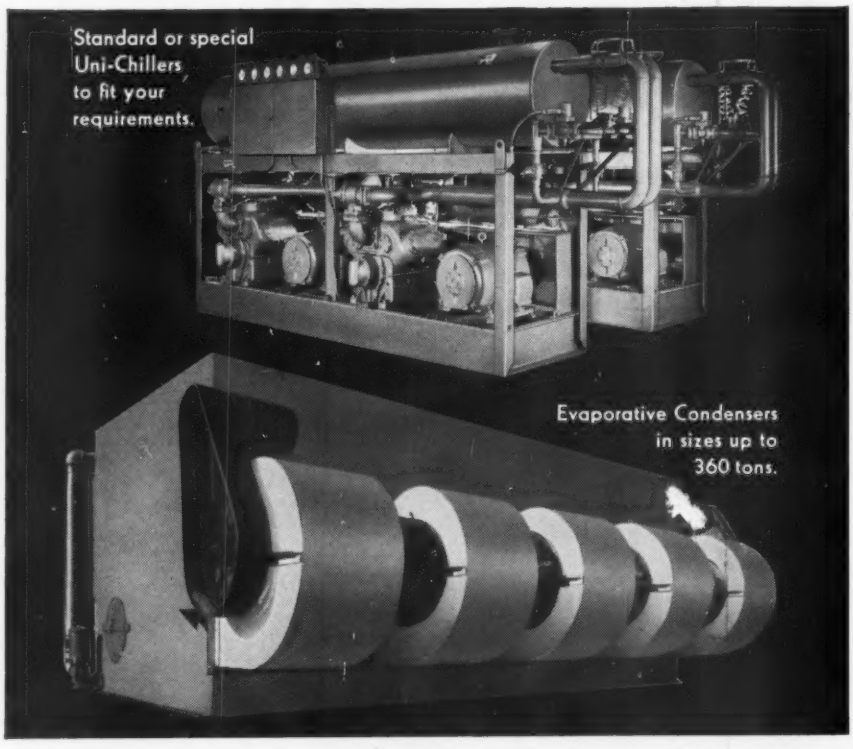

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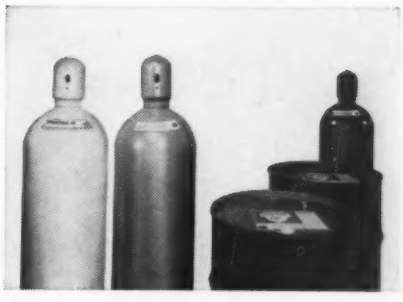

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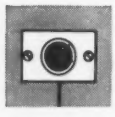
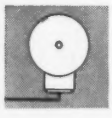
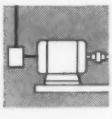


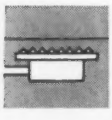
to actuate a signal light—signal an attendant to make the right moves in operating valves, pumps and the like—signal him when flow stops in a water cooled compressor, water cooled bearing and so on.



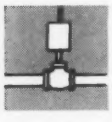
to sound an alarm—when flow stops in a process system or in any water cooled devices.



to start or stop motors—start pumps in sequence in multiple stage flow systems; start standby pumps; stop automatically controlled units if cooling water system fails; stop compressors in cooling systems when flow stops. These are *control* functions, and almost endless.



to start or stop automatic burners—start a booster heater when water draw occurs; stop burner if flow is improperly retarded; make sure of circulation in a boiler before burner is permitted to start.



to actuate metering device—open valve in chemical feeder line; start mixing in secondary line whenever flow starts in primary line.

Think it over! Some of these uses may suggest some related problem the FS4 can solve for you right now. Notice the facts about its construction and service range opposite.

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FS4-3 Single pole, double throw switch. Opens and closes two separate circuits with flow. Closes and opens same two circuits with no flow.

FS4 Closes with flow, opens with no flow.

FS4R Opens with flow, closes with no flow.

Underwriters' Listed

● Model E-2 available for larger pipe sizes and pressures to 150 psi.

Coupon brings bulletin

It covers design, construction, electrical ratings and dimensions. Points out many typical applications.

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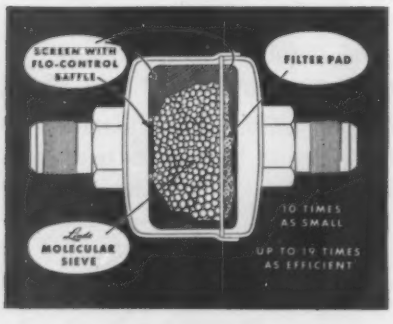

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copper water heating coils are built into the boiler, and two-temperature hot water can be made available if desired.

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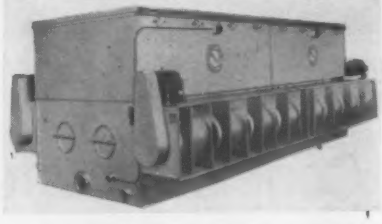
700-TON COOLING TOWER

Offering for the first time factory-assembled units up to this size as a standard line, this manufacturer has produced three models: centrifugal fan blow-through units (Model THA, shown); centrifugal fan draw-through (Model TUA), with single air inlets for attaching to ductwork; and tube-axial fan blow-through (Model TPA). Suitable for either indoor or outdoor installation, blow-through models up to 100 ton are also the first dry fan units offered by this company with connection flanges for ductwork on the air inlets as well as outlets.

Special features in the new line are large access doors located in both ends of all units, lift-out strainers of anti-cavitating design that can be cleaned and replaced without any mechanical effort, inspection ports on both sides, spray tree branches that



are removable for cleaning as well as the usual threaded spray nozzles, orifices and flush-through spray headers, and full-length access doors on draw-through units for removing eliminators and inspecting fans and bearings. **Baltimore Aircoil Company, Inc., P. O. Box 7322, Baltimore 27, Md.**

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Applicable at temperatures as low as −5 F, this polyvinyl chloride pipe protection tape is designed for conformability over a broad temperature range, with optimum properties for pipe corrosion protection. Designated "Scotchrap No. 40," it requires no heat or tools to apply and is cited as giving positive protection of joints, tees, couplings and other shapes.

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For free booklet on how to solve water problems, write:

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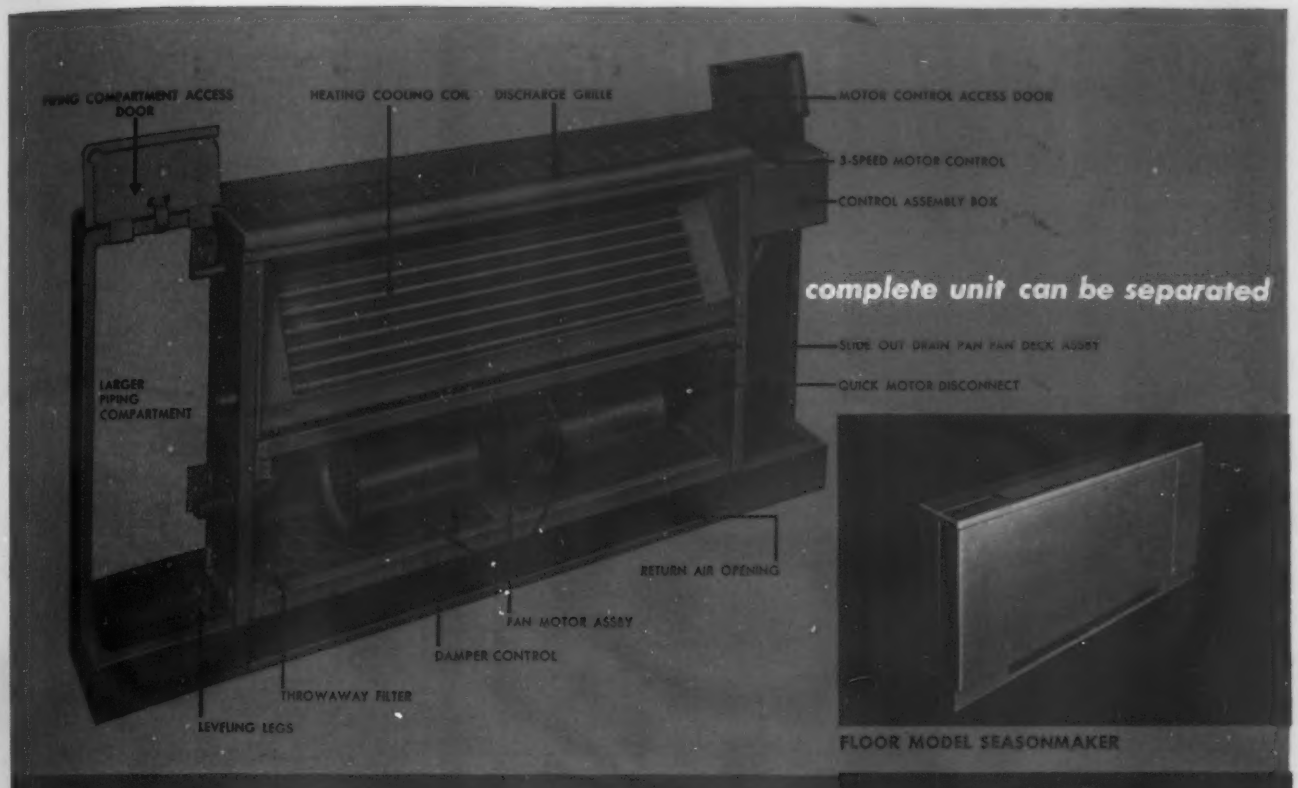
DIVISION OF HAGAN CHEMICALS & CONTROLS, INC.



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McQuay thin-line design SEASONMAKER

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All McQuay Seasonmakers utilize central station heating and cooling and are available with capacities of 220, 330, 440, 520 and 640 cfm. They furnish individual room comfort at any desired temperature level—heated, filtered air in winter and cooled, dehumidified and filtered air in summer. Seasonmakers are ideal for multi-room buildings such as hotels, apartments, motels, schools, hospitals, offices and residences.

If you haven't already done so, investigate McQuay individual room Seasonmakers. For complete information call the McQuay representative in or near your city, or write McQuay, Inc., 1606 Broadway St. N. E., Minneapolis 13, Minnesota.

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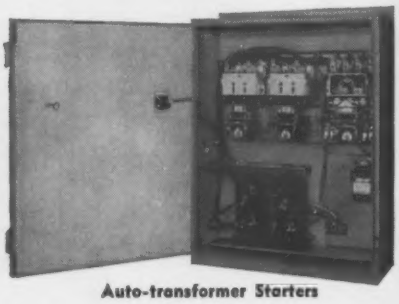

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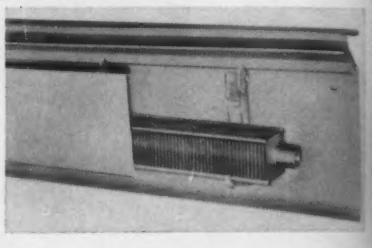

ers. Four expansion tracks interlocked to the corners of each fin provide "free-flow" expansion, with no clips or slide cradle devices required.
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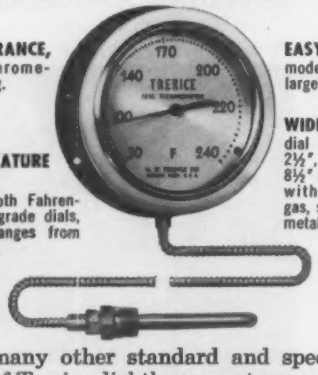

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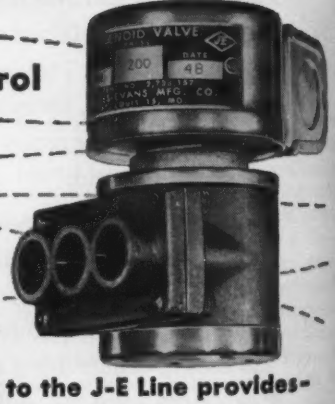

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